AD-A136 626 CONFERENCE ON STOCHASTIC PROCESSES AND THEIR APPLICATIONS (12TH) JULY 11-15 1983 ITHACA NEW YORK(U) CORNELL UNIV ITHACA NY 15 JUL 83 1/3

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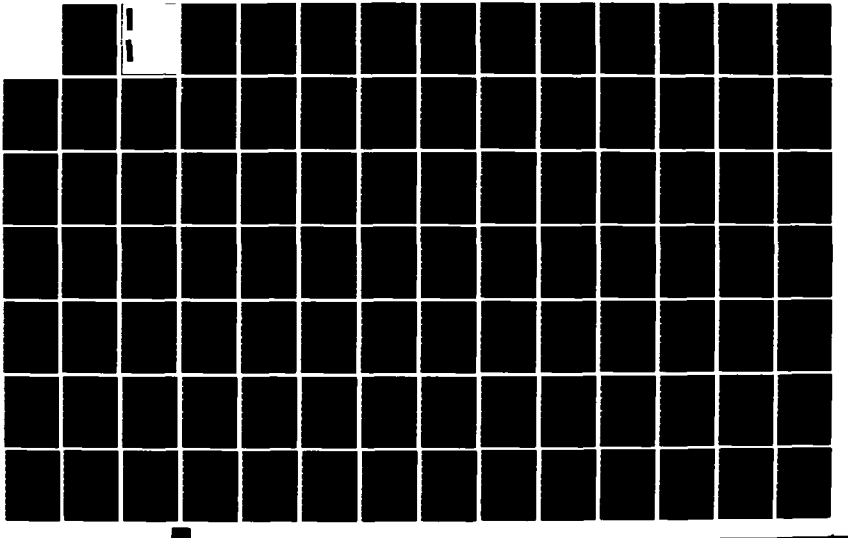

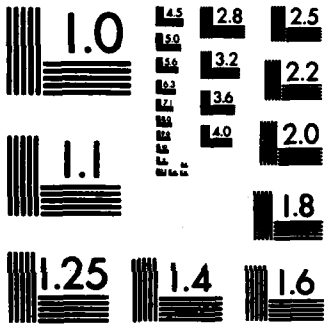

MICROCOPY RESOLUTION TEST CHART
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3:45 - 4:05 p.m. P. KOTELENEZ, Univ. Bremen, Fed.Rep.Germany
"Law of large numbers and central limit theorem for chemical reactions with diffusion"

STOCHASTIC MODELS III Warren 345

Chair: M. Rubinovitch

2:30 - 2:50 p.m. V.C. VANNICOLA, RADC/OCTS, Griffiss AFB, New York
"RF signals perturbed by oscillator phase instability"

2:55 - 3:15 p.m. M.N. GOPALAN, Indian Institute of Technology, Bombay
"Cost benefit analysis of systems subject to inspection and repair"

3:20 - 3:40 p.m. E. ARJAS, Univ. of Oulu, Finland

STOCHASTIC PROCESSES AND THEIR APPLICATIONS

TWELFTH CONFERENCE, JULY 11-15, 1983, ITHACA

Arranged under the Auspices of
COMMITTEE FOR CONFERENCES ON STOCHASTIC PROCESSES
of the
Bernoulli Society for Mathematical Statistics and Probability

Sponsored by

Cornell University's Office of Sponsored Programs,
Center for Applied Mathematics, School of Operations Research
and Industrial Engineering and College of Engineering

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Research and the Army Research Office

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Organizing Committee
E.B. Dynkin, D.C. Heath, H. Kesten, F.L. Spitzer,
M.S. Taqqu, H.M. Taylor and N.U. Prabhu (Chairman)

All talks in Warren 45

Contents:

Invited Talks

Speaker	Short Title	Day and Time	Chair
J. Kemperman	Measures with given marginals	Monday, 9:30-10:30	E.B. Dynkin
L.A. Shepp	Reflecting Brownian motion	Monday, 11:00-12:00	M. Taqqu
H. Kaspi	Extensions and invariant measures	Monday, 12:00-12:30	M. Taqqu
P. Major	Dyson's hierarchial model	Tuesday, 9:00-10:00	F. Spitzer
R. Holley	One dimensional stochastic Ising models	Tuesday, 10:00-10:30	F. Spitzer
M. Schal	Markov decision processes	Tuesday, 2:30- 3:30	S. Pliska
R. Kertz	Prophet problems	Tuesday, 4:00- 4:30	S. Pliska
E.L. Portens	Numerical methods	Tuesday, 4:30- 5:30	S. Pliska
J. Neveu	Stationary queues	Wednesday, 9:00-10:00	H. Kesten
L. Russo	Ergodicity and percolation	Wednesday, 10:00-10:30	H. Kesten
R. Serfozo	Thinning of point processes	Wednesday, 11:00-12:00	C.C. Heyde
P. Jagers	What is a stable population?	Wednesday, 12:00-12:30	C.C. Heyde
K. Parthasarathy	Quantum diffusion	Thursday, 9:00-10:00	H. Kaspi
S. Kotani	Schrodinger equations	Thursday, 10:00-10:30	H. Kaspi
B. Mandelbrot	Random fractiles	Thursday, 2:30- 3:30	W. Vervaat
E. Çinlar	Representation of Hunt processes	Friday, 9:00-10:00	D. Heath
H. Taylor	Fiber-matrix composite materials	Friday, 10:00-11:00	D. Heath
E.B. Dynkin	Random fields	Friday, 11:30-12:30	J. Neveu

cont. next page

Sessions on Contributed Papers

Title	Day and Time	Room	Chair
Branching processes;	Monday, 2:30- 3:40	Warren 231	T. Cox
Time series;	Monday, 2:30- 3:40	Warren 245	Y. Mittal
Stochastic models I;	Monday, 2:30- 3:40	Warren 345	L. Phoenix
Stable processes;	Monday, 4:00- 5:35	Warren 231	J. Mitro
Reliability;	Monday, 4:00- 5:35	Warren 245	J. Keilson
Stochastic control and optimal stopping I;	Monday, 4:00- 5:35	Warren 345	T. Berger
Markov processes;	Tuesday, 11:00-12:35	Warren 231	K. Athreya
Statistical inference from stochastic processes;	Tuesday, 11:00-12:35	Warren 245	L. Weiss
Stochastic integration;	Tuesday, 11:00-12:35	Warren 345	R. Syski
Self similar processes;	Thursday, 11:00-12:35	Warren 231	B. Mandelbrot
Queueing theory;	Thursday, 11:00-12:35	Warren 245	J.W. Cohen
Stochastic control and optimal stopping II;	Thursday, 11:00-12:35	Warren 345	M. Taksar
Markov and renewal processes;	Thursday, 11:00-12:35	Warren 145	R. Smith
Random fields;	Thursday, 4:00- 5:35	Warren 231	R. Holley
Renewal theory and random walks;	Thursday, 4:00- 5:35	Warren 245	J.H.B. Kemperman
Stochastic models II	Thursday, 4:00- 5:35	Warren 345	S. Schwager
Characterization and limit theorems;	Thursday, 4:00- 5:35	Warren 145	A. Karr
Mixing conditions and limit theorems;	Friday, 2:30- 4:05	Warren 231	J. Abrahams
Diffusion processes; and	Friday, 2:30- 4:05	Warren 245	E. Çinlar
Stochastic models III.	Friday, 2:30- 4:05	Warren 345	M. Rubinovitch

PROGRAM

SUNDAY JULY 10, 1983

7:00 - 10:00 p.m. Registration at Robert Purcell Union

MONDAY JULY 11, 1983

8:00 - 9:00 a.m. Registration at Robert Purcell Union

9:00 - 9:30 a.m. Welcome and Opening Remarks — Warren 45

N.U. PRABHU, Chairman, Organizing Committee
W.D. COOKE, Professor of Chemistry, Cornell Univ.
P. HOLMES, Director, Center for Applied Mathematics, Cornell Univ.
C.C. HEYDE, Chairman of the Committee for Conferences on Stochastic Processes.

9:30 - 10:30 a.m. Chair: E.B. Dynkin — Warren 45

J. KEMPERMAN, Univ. of Rochester
"Measures with given marginals"

10:30 - 11:00 a.m. Coffee Break

11:00 - 12:00 noon Chair: M. Taqqu — Warren 45

J.M. HARRISON, Stanford Univ.
H.J. LANDAU, Bell Laboratories
B.F. LOGAN, Bell Laboratories
L.A. SHEPP, Bell Laboratories
"The stationary distribution of reflecting Brownian motion in an arbitrary region"

12:00 noon - 12:30 p.m. Chair: M. Taqqu — Warren 45

H. KASPI, Technion, Israel
"Extensions and invariant measures for Markov processes"

12:30 - 2:30 p.m. LUNCH

1:00 - 2:00 p.m. Registration at Robert Purcell Union

BRANCHING PROCESSES — Warren 231

Chair: T. Cox

2:30 - 2:50 p.m. P. KÜSTER, Göttingen, Fed. Rep. Germany
"Asymptotic behavior of state-dependent Markov branching processes"

2:55 - 3:15 p.m. K.B. ATHREYA, Iowa State Univ.
"Cascades on a Galton-Watson tree "

3:20 - 3:40 p.m. A. GREVEN, Cornell Univ.
"A critical phenomenon for the coupled branching process "

TIME SERIES Warren 245

Chair: Y. Mittal

2:30 - 2:50 p.m. G. KALLIANPUR, Univ. N. Carolina, Chapel Hill
R.L. KARANDIKAR, Univ. N. Carolina, Chapel Hill
"Solution to the nonlinear filtering problem in the unbounded case "

2:55 - 3:15 p.m. J.P. CARMICHAEL, Laval Univ., Canada
J.C. MASSE, Laval Univ., Canada
R. THEOPORESCU, Laval Univ., Canada
"Characterization of second-order reciprocal stationary Gaussian processes "

3:20 - 3:40 p.m. P.J. BROCKWELL, Colorado State Univ.
R.A. DAVIS, Colorado State Univ.
"Recursive prediction and exact likelihood determination for Gaussian processes "

STOCHASTIC MODELS I Warren 345

Chair: L. Phoenix

2:30 - 2:50 p.m. R. SYSKI, Univ. Maryland
"Markov chains in geology "

2:55 - 3:15 p.m. N.R. RAO, Univ. Lagos, Nigeria
O.O. HUNPONU-WUSU, Univ. Lagos, Nigeria
"Stochastic models in epidemiology: some characteristics for parasitic and virologic diseases "

3:20 - 3:40 p.m. G. GIROUX, Univ. de Sherbrooke, Canada
"Note on the H-theorem for polyatomic gases "

3:40 - 4:00 p.m. Coffee Break

STABLE PROCESSES Warren 231

Chair: J. Mitro

4:00 - 4:20 p.m. E. MASRY, Univ. Calif., San Diego
S. CAMBANIS, Univ. N. Carolina, Chapel Hill
"Spectral density estimation for stationary stable processes"

4:25 - 4:45 p.m. C. HARDIN, Univ. N. Carolina, Chapel Hill
"Skewed stable variables and processes "

4:50 - 5:10 p.m. P. HALL, Australian National Univ.
"Sets which determine the rate of convergence to normal and stable laws "

5:15 - 5:35 p.m. J. MIJNHEER, Univ. Leiden, The Netherlands
"On the rate of convergence to a stable limit law "

RELIABILITY — Warren 245

Chair: J. Kielson

4:00 - 4:20 p.m. C.C. KUO, Cornell Univ.
S.L. PHOENIX, Cornell Univ.
"Recursion formulae for the lifetime distribution of a unidirectional fibrous material."

4:25 - 4:45 p.m. U. SUMITA, Univ. Rochester
J.G. SHANTHIKUMAR, Univ. Arizona
"General cumulative shock models"

4:50 - 5:10 p.m. S.F.L. GALLOT, D.S.I.R. New Zealand
"The supremum of a linear sum of stochastic processes "

5:15 - 5:35 p.m. N.N. ASAD, Lockheed - California
"A continuous stochastic process to represent damage initiation and growth."

STOCHASTIC CONTROL AND OPTIMAL STOPPING I — Warren 345

Chair: T. Berger

4:00 - 4:20 p.m. J.M. HARRISON, Stanford Univ.
T.M. SELLKE, Purdue Univ.
A.J. TAYLOR, Queen's Univ., Kingston, Ontario
"Impulse control of Brownian motion "

4:25 - 4:45 p.m. Y.C. LIAO, Univ. Kentucky
"On switching and impulse control "

4:50 - 5:10 p.m. M.I. TAKSAR, Stanford Univ.
"Average optimality criterion in the problems with unlimited control rates."

5:15 - 5:35 p.m. W. KLIEMANN, Univ. Bremen, Fed. Rep. Germany
"Controllability of stochastic systems "

8:00 - 10:00 p.m. RECEPTION Johnson Art Museum

TUESDAY JULY 12, 1983

9:00 - 10:00 a.m. Chair: F. Spitzer Warren 45

P. MAJOR, Hungarian Acad. of Sciences
"On Dyson's hierarchical model - critical phenomena and minimal laws in statistical physics "

10:00 - 10:30 a.m. Chair: F. Spitzer Warren 45

R. HOLLEY, Univ. of Colorado
"Rapid convergence in one dimensional stochastic Ising models "

10:30 - 11:00 a.m. Coffee Break

MARKOV PROCESSES Warren 231

Chair: K. Athreya

11:00 - 11:20 a.m. J.B. MITRO, Univ. of Cincinnati
"Time reversal depending on local time "

11:25 - 11:45 a.m. C. MACCONE, Politecnico di Tonna, Italy
"Energy and eigenfunction of time-inhomogeneous Brownian motion "

11:50 a.m. - 12:10 p.m. J. KEILSON, Univ. of Rochester
R. RAMASWAMY, Univ. of Rochester
"Convergence of quasi-stationary distributions in birth-death processes "

12:15 - 12:35 p.m. S.J. SCHWAGER
"The asymptotic distributions of run occurrences for Markov-dependent trials "

STATISTICAL INFERENCE FROM STOCHASTIC PROCESSES Warren 245

Chair: L. Weiss

11:00 - 11:20 a.m. R.L. SMITH, Imperial College, London
"Biased coin designs and martingales "

11:25 - 11:45 a.m. A.F. KARR, Johns Hopkins Univ.
"State estimation for Cox processes with unknown probability law "

11:50 a.m. - 12:10 p.m. Y. MITTAL, Virginia Polytech. Inst.
"Two dimensional projection pursuit tests for goodness of fit and equality of distributions "

12:15 - 12:35 p.m. C.C. HEYDE, CSIRO, Australia
"Confidence intervals for demographic projections "

STOCHASTIC INTEGRATION — Warren 345

Chair: R. Syski

11:00 - 11:20 a.m. A. WERON, Wroclaw Tech. Univ., Poland
"Hida type multiplicity representation for p-stable stochastic processes "

11:25 - 11:45 a.m. A MANDELBAUM, Cornell Univ.
M.S. TAQQU, Cornell Univ.
"Invariance principle for symmetric statistics "

11:50 a.m. - 12:10 p.m. D. NUALART, Univ. de Barcelona, Italy
"On the decomposition of a two-parameter martingale "

12:15 - 12:35 p.m. Z. HUANG, Wuhan Univ., People's Rep. China
"Stochastic integrals on general topological measurable spaces "

12:35 - 2:30 p.m. LUNCH

2:30 - 3:30 p.m. Chair: S. Pliska — Warren 45

M. SCHÄL, Univ. of Bonn, Fed. Rep. Germany
"Markov decision processes "

3:30 - 4:00 p.m. Coffee Break

4:00 - 4:30 p.m. Chair: S. Pliska — Warren 45

R. KERTZ, Georgia Inst. Tech.
"Prophet problems: complete comparisons of stop rule and supremum expectations "

4:30 - 5:30 p.m. Chair: S. Pliska — Warren 45

E.L. PORTEUS, Stanford Univ.
"Survey of numerical methods for discounted finite Markov and semi-Markov chains "

WEDNESDAY, JULY 13, 1983

9:00 - 10:00 a.m. Chair: H. Kesten — Warren 45

J. NEVEU, Univ. de Paris VI, France
"Construction of stationary queues "

10:00 - 10:30 a.m. Chair: H. Kesten — Warren 45

L. RUSSO, Vitali dell' Universita, Italy
"Approximate ergodicity and percolation "

10:30 - 11:00 a.m. Coffee Break

11:00 - 12:00 noon Chair: C.C. Heyde Warren 45

R. SERFOZO, Bell Laboratories
"Thinning of point processes "

12:00 noon - 12:30 p.m. Chair: C.C. Heyde Warren 45

P. JAGERS, Chalmers Univ. Tech, Sweden
"What is a stable population?"

12:30 - 2:30 p.m. LUNCH

1:15 p.m. Excursion to Corning Glass Museum

THURSDAY, JULY 14, 1983

9:00 - 10:00 a.m. Chair: H. Kaspi Warren 45

K. PARTHASARATHY, Indian Statistical Institute, New Delhi
"Quantum diffusion."

10:00 - 10:30 a.m. Chair: H. Kaspi Warren 45

S. KOTANI, Kyoto Univ., Japan
"On Schrödinger equations with random potentials."

10:30 - 11:00 a.m. Coffee Break

SELF-SIMILAR PROCESSES Warren 231

Chair: B. Mandelbrot

11:00 - 11:20 a.m. W. VERVAAT, Katholieke University, The Netherlands
"Sample path variation of self-similar processes with stationary increments "

11:25 - 11:45 a.m. F. W. STEUTEL, Eindhoven Univ. of Tech., The Netherlands
"Integer-valued self-similar processes"

11:50 a.m. - 12:10 p.m. J. LEVY, SUNY- Albany
"Modeling high variability and long-run dependence through the use of renewal sequences "

12:15 - 12:35 p.m. L. DE HAAN, Erasmus Univ., Rotterdam, The Netherlands
J. PICKANDS III, Univ. of Pennsylvania
"A spectral representation for stationary min-stable processes "

QUEUEING THEORY — Warren 245

Chair: J.W. Cohen

11:00 - 11:20 a.m. J. KEILSON, Univ. of Rochester
U. SUMITA, Univ. of Rochester
"The waiting time structure of M/G/1 queueing systems in tandem"

11:25 - 11:45 a.m. J.H.A. DE SMIT, Twente Univ. of Technology, The Netherlands
"Explicit Wiener-Hopf factorizations in the theory of queues"

11:50 a.m. - 12:10 p.m. W.A. MASSEY, Bell Laboratories
"New results for the Jackson network "

12:15 - 12:35 p.m. M. RUBINOVITCH, Northwestern Univ.
"The slow server problem"

STOCHASTIC CONTROL AND OPTIMAL STOPPING II — Warren 345

Chair: M. Taksar

11:00 - 11:20 a.m. I. KARATZAS, Columbia Univ.
"Gittins indices in the dynamic allocation problem for diffusion processes"

11:25 - 11:45 a.m. D. ZUCKERMAN, Hebrew Univ. of Jerusalem, Israel
"On preserving the reservation wage property in a continuous search model"

11:50 a.m. - 12:10 p.m. F.T. BRUSS, Univ. de Nemur, Belgium
"The e^{-1} law in best choice problems"

12:15 - 12:35 p.m. V. G. KULKARNI, Univ. of N. Carolina
"Machine maintenance and optimal stopping"

MARKOV AND RENEWAL PROCESSES — Warren 145

Chair: R. Smith

11:00 - 11:20 a.m. R. DURRETT, Univ. of California-Los Angeles
"On the phase transition in a branching random walk"

11:25 - 11:45 a.m. E. SLUD, Univ. of Maryland
"Multivariate dependent renewal processes"

11:50 a.m. - 12:10 p.m. R. ISAAC, Herbert H. Lehman College, CUNY
"Markov chain return times attracted to a stable law"

12:15 - 12:35 p.m. I. KARATZAS, Columbia University
S.E. SHREVE, Carnegie-Mellon Univ.
"Trivariate density of Brownian motion, its local and occupation time, with application"

12:35 - 2:30 p.m. LUNCH

2:30 - 3:30 p.m. Chair: W. Vervaat Warren 45

B. MANDELBROT, IBM T.J. Watson Reseach Center
"The construction of random fractiles: a survey and a list of open problems"

3:30 - 4:00 Coffee Break.

RANDOM FIELDS Warren 231

Chair: R. Holley

4:00 - 4:20 p.m. J. ABRAHAMS, Rice Univ. and Office of Naval Research
"Level-crossing distributions for random processes and supremum distributions for random fields"

4:25 - 5:05 p.m. D. GEMAN, Univ. of Massachusetts
S. GEMAN, Brown Univ.
U. GRENANDER, Brown Univ.
D. McCLURE, Brown Univ.
"The parallel realization of Markov random fields with applications"

5:15 - 5:35 p.m. T. BERGER, Cornell Univ.
F. BONOMI, Cornell Univ.
"Locally interacting Markov processes amenable to parallel updating"

RENEWAL THEORY AND RANDOM WALKS Warren 245

Chair: J.H.B. Kemperman

4:00 - 4:20 p.m. T. BERGER, Cornell Univ.
"Immutable random processes, Polya's theorem and local time"

4:25 - 4:45 p.m. H. THORISSON, Chalmers Univ. of Technology, Sweden
"Renewal theory with periodic time-dependence"

4:50 - 5:10 p.m. P. CERRITO, Univ. of South Florida
"Random walks on topological inverse semigroups"

5:15 - 5:35 p.m. J.T. COX, Syracuse Univ.
D. GRIFFEATH, Univ. of Wisconsin
"Large deviation probabilities for occupation times of a system of non-interacting random walks"

STOCHASTIC MODELS II — Warren 345

Chair: S. Schwager

4:00 - 4:20 p.m. D. PERRY, Technion, Israel

"Inventory systems of perishable commodities"

4:25 - 4:45 p.m. S. J. WOLFE, Univ. of Delaware
"Continuity properties of decomposable probability measures on Euclidean spaces"

4:50 - 5:10 p.m. S. ASMUSSEN, Univ. of Copenhagen, Denmark
"Conjugate distributions and variance reduction in ruin probability simulation"

5:15 - 5:35 p.m. J.J. EGOZCUE, Univ. Politecnice de Barcelona, Spain
J. PAGÉS, Univ. Politecnice de Bardelona, Spain
"Power bias in maximum entropy spectral analysis"

CHARACTERIZATION AND LIMIT THEOREMS — Warren 145

Chair: A. Karr

4:00 - 4:20 p.m. I.B. MACNEILL, Univ. of Western Ontario, Canada
V.K. JANDHYALA, Univ. of Western Ontario, Canada
"The residual process for non-linear regression"

4:25 - 4:45 p.m. V. GOODMAN, Indiana Univ.
A. RALESCU, Indiana Univ.
"Almost sure decay rates for norms of weighted empirical distributions"

4:50 - 5:10 p.m. Y. ITO, Nagaya Univ., Japan
I. KUBO, Hiroshima Univ., Japan
"Characterizations of Brownian and Poisson white noise"

5:15 - 5:35 p.m. V. WIHSTUTZ, Univ. of Bremen, Fed.Rep.Germany
"Parameter dependence of Lyapunov characteristic numbers"

8:00 p.m. BANQUET Memorial Room, Willard Straight Hall

FRIDAY JULY 15, 1983

9:00 - 10:00 a.m. Chair: D. Heath — Warren 45

E. ÇINLAR, Northwestern Univ.
"Representation of Hunt processes"

10:00 - 11:00 a.m. Chair: D. Heath — Warren 45

H. TAYLOR, Cornell Univ.
"A survey of models and results for fiber-matrix composite materials"

11:00 - 11:30 a.m. Coffee Break

11:30 a.m. - 12:30 p.m. Chair: J. Neveu — Warren 45

E.B. DYNKIN, Cornell University
"Random fields associated with Markov processes and their applications"

12:30 - 2:30 p.m. LUNCH

MIXING CONDITIONS AND LIMIT THEOREMS — Warren 231

Chair: J. Abrahams

2:30 - 2:50 p.m. H.C.P. BERBEE, Mathematical Centre, The Netherlands
"A strong law and mixing rates"

2:55 - 3:15 p.m. R.C. BRADLEY, Indiana Univ.
"On a very weak Bernoulli condition"

3:20 - 3:40 p.m. M. HAREL, Institute of Technology of Limeges, France
"Weak convergence of weighted and split multi-dimensional empirical processes and truncation"

3:45 - 4:05 p.m. Y. KIFER, Univ. of Maryland
"Perturbations of random matrix products"

DIFFUSION PROCESSES — Warren 245

Chair: E. Çinlar

2:30 - 2:50 p.m. J. BRODE, Univ. of Lowell
"Martingale models based on Feller-Dynkin diffusions"

2:55 - 3:15 p.m. M. BERGER, Georgia Institute of Technology
A. SLOAN, Georgia Institute of Technology
"Solutions of evolution equations by stochastic characteristic methods"

3:20 - 3:40 p.m. AUTHOR NOT KNOWN
"Probabilistic solution of the Dirichlet problem for biharmonic functions in discrete space"

3:45 - 4:05 p.m. P. KOTELENEZ, Univ. Bremen, Fed.Rep.Germany
"Law of large numbers and central limit theorem for chemical reactions with diffusion"

STOCHASTIC MODELS III — Warren 345

Chair: M. Rubinovitch

2:30 - 2:50 p.m. V.C. VANNICOLA, RADC/OCTS, Griffiss AFB, New York
"RF signals perturbed by oscillator phase instability"

2:55 - 3:15 p.m. M.N. GOPALAN, Indian Institute of Technology, Bombay
"Cost benefit analysis of systems subject to inspection and repair"

3:20 - 3:40 p.m. E. ARJAS, Univ. of Oulu, Finland
P. HAARA, Univ. of Oulu, Finland
"Censoring and conditional sufficiency in a marked point process setup"

3:45 - 4:05 p.m. S.N. SINGH, Banaras Hindu Univ., India
"On the utility of some probability distributions for number of births"

4:05 p.m. END OF CONFERENCE

STOCHASTIC PROCESSES AND THEIR APPLICATIONS

TWELFTH CONFERENCE, JULY 11-15, 1983, ITHACA

PROGRAM - ADDENDUM

THURSDAY JULY 14, 1983

RANDOM FIELDS — Warren 231

5:40 - 6:00 p.m. R.J. ADLER, Technion, Israel
"Exact distributions of the maximum of some Gaussian random fields"

CHARACTERIZATION AND LIMIT THEOREMS — Warren 145

5:40 - 6:00 p.m. X.C. WANG, Jilin Univ., China
M.B. RAO, Sheffield Univ., England
"Some limit theorems for weighted sums of sequences of Banach-space valued random variables"

FRIDAY JULY 15, 1983

FURTHER TOPICS IN STOCHASTIC PROCESSES — Warren 145

Chair: R.J. Adler

2:30 - 2:50 p.m. M. METIVIER, Ecole Polytechnique, France
"On stochastic algorithms considered by Ljung and Kushner and Clark"

2:55 - 3:15 p.m. J. GIGLMAYR, Heinrich-Hertz Institute, Fed. Rep. Germany
"On the Kolmogorov-Feller equations for cut-off Markov processes"

*3:20 - 3:40 p.m. C. HARDIN, Univ. N. Carolina, Chapel Hill
"Skewed stable variables and processes"

* Postponed from Monday, July 11, 4:25 - 4:45 p.m.

MEASURES WITH GIVEN MARGINALS

J. H. B. Kemperman, University of Rochester

Consider an unknown measure μ on a fixed completely regular product space S, whose marginals belong to prescribed classes, and which satisfies an additional collection of moment conditions. Some of these may require that μ lives on a given set D, or that μ possesses a density relative to a reference measure which satisfies certain bounds.

We give new and old results concerning necessary and sufficient conditions for the existence of such a measure μ, concerning efficient algorithms and optimal bounds for related moments.

These will be applied to obtain new results for distances between measures on a metric space such as the Prohorov distance and Wasserstein distance; to median polish and comparison of experiments; to exact and approximate dilations between measures, defined by a fixed convex cone K of functions; often K is invariant under the maximum operation.

Monday 9:30 - 10:30

THE STATIONARY DISTRIBUTION OF REFLECTING BROWNIAN MOTION IN AN ARBITRARY REGION

by

J. M. Harrison*
Stanford University
Stanford, California

and

H. J. Landau
B. F. Logan
L. A. Shepp
Bell Laboratories
Murray Hill, New Jersey 07974

ABSTRACT

Stroock and Varadhan and others have shown that for (essentially) any region A of k-space and unit-vector-field ϕ on the boundary ∂A of A, ϕ pointing into A, there is a (unique) reflecting Brownian motion $B = B(t; A,\phi)$ which diffuses locally like a Wiener process inside A and reflects back into A along $\phi(a)$ for $a \in \partial A$. We give explicitly for the first time the stationary distribution μ on A of B when it exists in a very general case, namely when $k = 2$ for an arbitrary simply-connected region A and an arbitrary vector field ϕ on ∂A. In spite of much effort, μ was previously known only when A is a half-strip and ϕ is constant along the sides and is actually perpendicular on two of the three sides. We were greatly aided by work of Newell in finding these results.

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*This work was done while Dr. Harrison was a consultant at Bell Laboratories.

EXTENSIONS AND INVARIANT MEASURES FOR MARKOV PROCESS

H. Kaspi
Faculty of Industrail Engineering and Management
Technion, Haifa, ISRAEL

During recent years there has been a large body of work on the theory of excursions of Markov processes. The theory of excursions from a point, considered from point of view of regeneration led to a construction of invariant measure for the process. This measure was expressed in terms of the excursions entrance laws and the drift parameter of the inverse of the local time at the point.

We shall consider excursions induced by a continuous additive function $L = \{L_t : t \geq 0\}$. We show that if the boundary process $Y = X_{\tau_s} : s \geq 0$ (τ being the inverse of L) is Harris recurrent, then the original process X has a σ-finite invariant measure. This measure is again expressed in terms of the drift functional of τ, the excursions entrance laws and the invariant measure μ of Y, and is concentrated on the set of points from which the fine support of L is attained.

This result provides a tool for level crossing analysis of storage systems, in the same manner that the main theorem for regenerative systems does, when the regeneration sets are discrete. Some simple examples will be discussed.

Monday 12:00 - 12:30

ON DYSON'S HIERARCHICAL MODEL. CRITICAL PHENOMENA AND UNIVERSAL LAWS IN STATISTICAL PHYSICS.

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Equilibrium states in statistical physics are probability measures defined rather implicitely and depending on a physical parameter, the temperature. In interesting cases there is one particular value of the parameter, the so-called critical temperature, at which equilibrium state behaves in a unique manner. Thus while in all other cases the correlation function decreases exponentially, at the critical temperature its decrease is only polynomial. As a consequence in this case we have limit theorems with unusual normalization.

We are also interested in the model when the parameter is in a small neighbourhood of the critical one. Although the value of the critical parameter heavily depends on the model, near the critical parameter many important characteristics behave similarly for large classes of models. The understanding of this phenomenon, called universality, is of primary importance both for modern mathematics and physics.

Unfortunately very few rigorous results are known. For Dyson's hierarchical model rigorous results can be obtained, and they show all the above indicated phenomena. Hence its study may help us to understand the general situation.

RAPID CONVERGENCE IN ONE DIMENSIONAL STOCHASTIC ISING MODELS

Richard Holley
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Boulder, Colorado 80309

We consider one dimensional stochastic Ising models whose interactions are finite range and translation invariant. It is shown that if the corresponding flip rates are chosen to be strictly positive, translation invariant, and finite range, but otherwise arbitrary, then the semi-group of the stochastic Ising model converges exponentially fast in the L^2 space of the Gibbs state. If in addition the flip rates are attractive, the results are extended to yield exponentially fast pointwise convergence of the semi-group acting on the local observables.

Tuesday 10:00 - 10:30

MARKOV DECISION PROCESSES

M. Schäl
University of Bonn

The field of Markov decision theory or stochastic dynamic programming is more than two decades old now.

The related theories of gambling and optimal stopping developped nearly independently though some strong connections to Markov decision theory were evident. Only quite recently one is able to present the three theories in a unified framework which is mainly built on the concepts of the theory of gambling.

From the outset the interest turned upon the (ε-) optimality of stationary policies (strategies). In the paper the present state of research is explained. Due to results of the last years the theory has considerably been rounded off.

PROPHET PROBLEMS: COMPLETE COMPARISONS OF STOP RULE AND SUPREMUM EXPECTATIONS

Robert P. Kertz
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Georgia Institute of Technology
Atlanta, Georgia 30332

In "prophet problems," the optimal return of a gambler, $V(X_1,\ldots,X_n) = \sup\{EX_t: t \text{ is a stop rule for } X_1,\ldots,X_n\}$, is compared to the expected return of a prophet, $E(\max_{j\le n} X_j)$, playing the same game. Specifically, for a class C_n of stochastic processes, one attempts to describe precisely the set of ordered pairs $\{(x,y): x = V(X_1,\ldots,X_n) \text{ and } y = E(\max_{j\le n} X_j) \text{ for some } (X_1,\ldots,X_n) \in C_n\}$. Such regions have been given for several classes of processes (e.g., see [1,2]). In each case, the region gives a family of sharp inequalities $E(\max_{j\le n} X_j) - \psi_n(a) \le aV(X_1,\ldots,X_n)$ satisfied for all $(X_1,\ldots,X_n) \in C_n$ and for all a in some interval I_n. We review these results and relate them to recent research on prophet regions for exchangeable processes.

References

[1] Hill, T. P. and Kertz, R. P. (1983). Stop rule inequalities for uniformly bounded sequences of random variables. Trans. Amer. Math. Soc. (to appear).

[2] Kertz, R. P. (1983). Stop rule and supremum expectations of i.i.d. random variables: a complete comparison by conjugate duality (submitted).

Key words and phrases: optimal stopping, extremal distributions, inequalities for stochastic processes, conjugate duality, Young's inequality.

Tuesday 4:00 - 4:30

SURVEY OF NUMERICAL METHODS FOR DISCOUNTED FINITE MARKOV AND SEMI-MARKOV CHAINS

Evan L. Porteus
Stanford University

This survey will cover a variety of numerical methods used to solve a system of linear equations of the form $v = r + Pv$, where P is nonnegative and has a spectral radius strictly less than one. These equations arise when seeking (1) the expected present value of the returns from a finite Markov or semi-Markov reward chain over an infinite horizon, (2) the invariant probability vector of an irreducible, aperiodic Markov chain, and (3) other objects of lesser connection to stochastic processes. The methods surveyed include iterative methods (with the possible use of reordered states and extrapolations), direct methods, and aggregation.

Keywords: Algorithms, Markov Chains, Expected Discounted Return, Invariant Probability Vector, Iterative Methods

Short Title: Algorithms for Discounted Finite Markov Chains

Tuesday 4:30 - 5:30

CONSTRUCTION OF STATIONARY QUEUES

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Given a stationary random measure on R which represents the customers demand (say $N(\omega,\cdot) = \sum_{\mathbb{Z}} \sigma_n(\omega)\, \varepsilon_{T_n(\omega)}$ or $\sigma(\theta_t\omega)\, dt$ with $N(\theta_t\omega,\cdot) = N(\omega,\cdot - t)$) with no independance assumptions, it is both theoretically interesting and practically important to build the stationary queue associated to N under various disciplines (k servers with service in the order of arrivals, reject discipline, autonomous server, etc). The discussion centers around the (minimal) extension of the initial probability space on which N is defined which must be introduced to obtain the solution. A survey of the subject will be presented.

Point processes, stationary queues.

APPROXIMATE ERGODICITY AND PERCOLATION

L. Russo
Instituto Matematico G. Vitali dell' Universita
Modena, Italy

We prove a property of finite Bernoulli systems which can be regarded as an analog of ergodicity.

This result, obtained as a consequence of the theorem proved in [1], can be applied to some problem in multidimensional percolation theory.

[1] L. Russo: "An Approximate Zero-One Law" Z. Wahrscheinlichkeitstheorie verw. Geb. 61, 129-139, 1982.

Key Words: Bernoulli schemes
Percolation.

THINNINGS OF POINT PROCESSES

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This talk gives a survey of limit theorems for thinned point processes. Various thinning procedures are described in which the thinned point process converges to a Poisson, Cox or infinitely divisible process. Thinnings of cluster processes, multivariate processes and random measures are also discussed. For instance, conditions are given under which thin partitions of a point process converge to independent Poisson processes. These results are extensions of the classical Poisson approximation for a Bernoulli process of rare events. Their proofs involve the use of compositions of random measures, Laplace functionals and martingales.

Keywords: Point process, random measure, Poisson process, cluster process, rare events, infinite divisibility.

WHAT IS A STABLE POPULATION?

Peter Jagers

**Chalmers University of Technology and
the University of Gothenburg, Sweden**

An unrestricted population, which does not die out, must grow towards infinity. If individuals reproduce in an i.i.d. manner, this even occurs exponentially at the classical Malthusian rate. By some law of large numbers the composition of the population should then stabilize. Thus a stable (exponentially growing) branching population arises, one aspect of which is the stable age distribution of demography. The lecture aims at a precise formulation of the probability space describing such a stable population and discusses the convergence of empiric branching population compositions towards the stable population. Some applications are mentioned, like the probability of being first-born.

Wednesday 12:00 - 12:30

QUANTUM DIFFUSION

K.R. Parthasarathy
Indian Statistical Institute
New Delhi, India

The notion of a noncommutative semimartingale adapted to Brownian motion process is introduced. Under some regularity conditions such semimartingales are expressed as a sum of integrals with respect to "quantum Brownian motion" and Lebesgue measure. This is used to construct examples of quantum diffusion processes for position and momentum variables. The method leads to a noncommutative Feynman-Kac formula.

Key words : Smooth semimartingale, Smooth martingale, Annihilation and creation martingales, Quantum Ito's formula, Quantum diffusion, noncommutative Feynman-Kac formula.

Thursday 9:00 - 10:00

ON SCHRÖDINGER EQUATIONS WITH RANDOM POTENTIALS

Shinichi Kotani
Kyoto University, Japan

Let $(\Omega,\mathcal{F},P)$ be a probability space and $\{T_x : x\in R^1\}$ be a one-parameter group of P-preserving measurable transformations on Ω. Assume $\{T_x,P,\Omega\}$ is ergodic. For a bounded measurable function q on Ω, we can define a self-adjoint operator $L(\omega)$ on $L^2(R^1,dx)$ by

$$L(\omega) = -\frac{d^2}{dx^2} + q(T_x\omega) \quad ,$$

which is called Schrödinger operator. One thing which is interesting from the point of view of probability theory is that if the stationary process $\{q(T_x\omega)\}$ is non-deterministic, then the spectral measure has no absolutely continuous component.

keywords: Schrödinger operator, non-deterministic stationary process, almost periodic function.

Thursday 10:00 - 10:30

THE CONSTRUCTION OF RANDOM FRACTALS: A SURVEY AND A LIST OF OPEN PROBLEMS

Benoit B. Mandelbrot

IBM T. J. Watson Research Center, Yorktown Heights, NY

The first fractal models of nature were centered around known random processes. These processes' particular-looking properties (e.g., infinite variance or span of dependence) were shown to be extremely desirable if one is to account for correspondingly peculiar properties of the world.

The supply of ready-made models from the probabilist's repertory is now exhausted. Several newly devised classes of random processes will be sketched, tricks used in devising them will be pointed out, and a large number of new mathematical conjectures will be stated.

keywords: fractals, open problems

Thursday 2:30 - 3:30

REPRESENTATION OF HUNT PROCESSES

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Every Hunt process satisfies a stochastic integral equation after a change of time and space. The equation involves Wiener processes and Poisson random measures as the sources of randomness. This complements the results of FELLER and DYNKIN on the characterization of continuous strong Markov processes on the real line. As an intermediate result we characterize all martingales of the filtration of the Hunt process. (Joint work with J. JACOD.)

Keywords: Hunt processes, martingales, stochastic integrals.

A SURVEY OF MODELS AND RESULTS FOR FIBER-MATRIX COMPOSITE MATERIALS

Howard M. Taylor
Cornell University

Several models for the strength and time-to-failure of fiber-matrix composite materials are presented together with sketches of their analysis and summaries of the major results. The models are series-parallel load sharing systems in which load sharing is concentrated in the near vicinity of failed elements. Methods of analysis include: (i) Numerical computation for small systems, (ii) An asymptotic technique based on extreme value theory, (iii) A recursion that studies the effect of system size. A major result is the concept of a critical crack size where-in system failure occurs once a sufficient number of adjacent or nearby elements have failed.

RANDOM FIELDS ASSOCIATED WITH MARKOV PROCESSES AND THEIR APPLICATIONS

E.B. Dynkin
Cornell University

Let X_t be a Markov process on a space E with a symmetric transition density $p_t(x,y)$ and let $g(x,y)=\int_0^\infty p_t(x,y)dt < \infty$ for almost all x,y. Two random fields over E are associated with X_t. One - the free field φ_x - is a Gaussian random field with mean 0 and the covariance function g(x,y). The second - the occupation field T_x - characterizes the amount of time spent by particle at each point $x \in E$ during the life-time $[0, \zeta)$. There exists an intimate relation between these fields which makes possible to use Markov processes as a tool in statistical physics and quantum field theory. On the other hand, techniques of field theory can be applied to investigate local times and self-crossings of Markov paths.

ASYMPTOTIC BEHAVIOUR OF STATE-DEPENDENT MARKOV BRANCHING PROCESSES

Petra Küster
Universität Göttingen

The almost sure limiting behaviour of some Markov processes which generalize the supercritical Markov branching processes is studied. The life-time distributions are again independent and exponentially distributed with identical intensities. The offspring distributions are now allowed to be state-dependent with expectations which are non-increasing while the state increases. Most of the results for ordinary supercritical Markov branching processes are generalized, including a necessary and sufficient condition for divergence (with natural rate), similar to the (xlogx)-condition.

key words: supercritical branching processes, Markov populations, almost sure convergence, sub-exponential growth

Monday 2:30 - 2:50

CASCADES ON A GALTON-WATSON TREE

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Let $\{X_{nj}: j=1, 2, \ldots; n=0, 1, 2, \ldots\}$ be a double array of independent nonnegative random variables such that for each n, the r.v. $\{X_{nj}; j=1, 2, \ldots\}$ are i.i.d. with c.d.f. $F(\rho^n x)$ where F(.) is a c.d.f. Associate with the Z_n members of the n^{th} generation of a Galton-Watson tree, the random variable $\{X_{nj}; j=1, 2, \ldots, Z_n\}$. For any member of the n^{th} generation in the population let $\sum_{i=1}^{n} X_{ij_i}$ denote the distance reached by that member from where his ancestors left off. Call the locations $\{Y_1, Y_2, \ldots, Y_{Z_n}\}$ and $M_n = \max(Y_1, Y_2, \ldots, Y_{Z_n})$. It is shown that for $\rho > 1$, M_n converges w.p.1. to a limit M whose c.d.f. F(.) satisfies a functional equation. The existence and uniqueness of solutions to this equation are discussed.

A CRITICAL PHENOMENON FOR THE "COUPLED BRANCHING PROCESS"

Andreas Greven
Department of Mathematics, Cornell University

We consider a Markov process (η_t^μ) on $(\mathbb{N})^S$ $(S=\mathbb{Z}^d)$, where $\eta_t^\mu(x)$ is interpreted as the number of objects at site x and at time t. The process evolves as follows: At rate $b\cdot\eta(x)$ a particle is born at site x, which moves instantaneously to a site y chosen with probability $q(x,y)$. All particles at a site die at rate $p\cdot d$, individual particles die independent from each other at rate $(1-p)d$. Furthermore, all particles perform independent continuous time random walks.

The process exhibits a critical phenomenon with respect to the parameter p: For $p < p^*$, $\mathcal{L}(e^{-(b-d)t}\,\eta_t^\mu)$ converges weakly to a nondegenerated probability measure, while for $p \geq p^*$ it converges to $\delta_{\{\eta\equiv 0\}}$ and the process dies out locally almost surely. p^* can be calculated explicitly. $E_{\nu(p)}(\eta(x)-E(\eta(x)))^2$, with $\nu(p)$ an equilibrium state for the parameter value p, diverges for $p \nearrow p^*$. The rate of divergence obeys a universal power law.

Short title: The Coupled Branching Process

Key words: Infinite particle systems, Critical Phenomenon

SOLUTION TO THE NONLINEAR FILTERING PROBLEM IN THE UNBOUNDED CASE

G. Kallianpur and R.L. Karandikar
Department of Statistics
University of North Carolina at Chapel Hill

In the finitely additive white noise model (1) for nonlinear filtering

$$y_t = h_t(x_\cdot) + e_t \quad , \quad 0 \le t \le T,$$

where the signal (x_t) is a R^d-valued diffusion and (e_t) is Gaussian white noise on a finitely additive probability space, assuming only that h is locally Holder continuous, it is shown that for y belonging to a dense set of observations, the unnormalized conditional density of x_t given $\{y_s: s \le t\}$ exists and is the unique solution to "Zakai type" partial differential equation.

(1) G. Kallianpur and R.L. Karandikar, A finitely additive white noise approach to nonlinear filtering, To appear in J. Appl. Mathematics and Optimization (1983).

Monday 2:30 - 2:50

CHARACTERIZATION OF SECOND-ORDER RECIPROCAL STATIONARY GAUSSIAN PROCESSES

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Short title: Second-order reciprocal processes.

Our aim is to characterize second-order reciprocal stationary Gaussian processes with continuous parameter in terms of their covariance matrix function. A third order matrix differential equation is derived whose solutions are, subject to parameter restrictions, the covariance matrix functions of such processes. Instrumental for obtaining these results is a factorization property of the covariance matrix function.

Keywords: Stationary Gaussian processes, second-order reciprocal processes, characterization.

Monday 2:55 - 3:15

RECURSIVE PREDICTION AND EXACT LIKELIHOOD DETERMINATION FOR GAUSSIAN PROCESSES

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Simple recursion relations are given for the coefficients c_{nj} in the representation

$$\hat{X}_n = \sum_{j=1}^{n-1} c_{nj}(X_j - \hat{X}_j),$$

of $\hat{X}_n = E(X_n | X_{n-1}, \ldots, X_1)$ where $\{X_n\}$ is any zero-mean Gaussian process whose covariance matrices $\Gamma_n = [E(X_i X_j)]_{i,j=1,\ldots,n}$ are all non-singular. The likelihood of $(X_1, \ldots, X_n)$ is expressed explicitly in terms of $X_1, \ldots, X_n, \hat{X}_1, \ldots, \hat{X}_n$ and the variances $v_n = E(X_n - \hat{X}_n)^2$, which are also determined by the basic recursion relations. In the special case when $\{W_n\}$ is an ARMA (p, q) process the recursion relations yield a simple recursive scheme for determining the coefficients d_{nj} in the representation

$$\hat{W}_n = \phi_1 W_{n-1} + \ldots + \phi_p W_{n-1} + \sum_{j=n-q}^{n-1} d_{nj}(W_j - \hat{W}_j),$$

$$n > \max(p, q),$$

and a corresponding expression for the likelihood function is derived. The recursion relations are extremely simple to use, espcially for small values of p and q.

Key works: best predictor, likelihood function, Gaussian processes, ARMA processes.

Monday 3:20 - 3:40

MARKOV CHAINS IN GEOLOGY

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A specific Markov chain model describing fluctuations in lithologic sequences is analyzed with emphasis on passage times and potential theoretic aspects. Although Markov chains have been employed in Geology earlier (mostly in their statistical aspects), the present study attempts to formulate the new approach in this recently developing field of applications.

STOCHASTIC MODELS IN EPIDEMIOLOGY: SOME CHARACTERISTICS FOR PARASITIC AND VIROLOGIC DISEASES.

N. R. RAO AND O. O. HUNPONU-WUSU
UNIVERSITY OF LAGOS, LAGOS, NIGERIA.

In the stochastic model for malaria the mathematical expressions, derived earlier by the author (1), for the infection rate and the probability of natural recovery as a function of the population affected will be reviewed. For the poliomyelitis, the model constructed by Cvejetanovic et al (2) giving mathematical expressions of the epidemiological classes in the form of a two dimensional matrix, will also be reviewed.

The importance of the parameters-t he infection rate in mosquito for the transmission of malaria and the age of children exposed to risk of Polio - is highlighted.

(1) Rao, N.R. et al (1976)
Quantitative studies, Part IV:
Application of the model for P.Vivax epidemiology
Bull. Haffkine Instt. 4 (1): 1-7

(2) Cvjetanovic, B; Gral, B and Dixon H. (1982)
Epidemiological models of Poliomyeletis
Bull. Wld. Hlth. Orgn; 60 (3): 405-422

Short Title: models for malaria and poliomyelitis.

Key words: Stochastic model, infection rate, probability of natural recovery, epidemiological classes.

NOTE ON THE H-THEOREM FOR POLYATOMIC GASES

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Boltzmann's H-theorem for a classical gas of polyatomic molecules may be seen as a particular case of an abstract general theorem whose proof is based on a data processing result and an equality containing a variational principle. Reversibility is not assumed.

Key words: H-theorem; stochastic kernel; polyatomic gases; entropy gain

SPECTRAL DENSITY ESTIMATION FOR STATIONARY STABLE PROCESSES

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Weakly and strongly consistent nonparametric estimates, along with rates of convergence, are established for the spectral density of certain stationary stable processes. This spectral density plays a role, in linear inference problems, analogous to that played by the usual power spectral density of second order stationary processes.

AMS 1970 Subject Classification: Primary 60G10, 62M15.

KEYWORDS: Stationary stable processes, nonparametric spectral density estimation

Monday 4:00 - 4:20

SKEWED STABLE VARIABLES AND PROCESSES

Clyde Hardin
University of North Carolina

Most work in stable processes has heretofore been concerned only with those having symmetric distributions. We prove some preliminary results for these processes when the symmetry requirement has been dropped. In particular, the form of all independent increments stable processes is determined, and a Wiener-type stochastic integral with respect to these processes is developed. We prove a representation theorem which says, loosely, that all stable processes are integrals with respect to a stable process with independent stationary increments and "maximum skewness." Also, some regression problems are solved, and it is shown that (unlike in the symmetric case) regressions of one stable variable upon another can be non-linear.

Keywords: Stable process, stochastic integrals, skewness, regression

Monday 4:25 - 4:45

SETS WHICH DETERMINE THE RATE OF CONVERGENCE TO NORMAL AND STABLE LAWS

Peter Hall
Australian National University

The most common method of describing rates of convergence in the central limit theorem, is in terms of the uniform metric. For example, the Berry-Esséen inequality provides a simple upper bound. Considerable theoretical interest centres on the case where the rate is slower than order $n^{-\frac{1}{2}}$, n being the sample size. Curiously, in this situation the rate of uniform convergence can be worked out by examining the normal error at only two points. Such pairs of points could be called "rate of convergence determining sets". This result does not extend to rates of convergence to non-normal stable laws. In those cases, there does not exist even a bounded set on which the rate of convergence is the same as in the uniform metric. Thus, there cannot exist a finite set which determines the rate of convergence to a non-normal stable law.

Short title: Rates of convergence.

Key words: Normal law, rate of convergence, stable law.

ON THE RATE OF CONVERGENCE TO A STABLE LIMIT LAW

Joop Mijnheer
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Let $X_1, X_2, \ldots$ be a sequence of independent identically distributed random variables with a common distribution function G. Let G be in the domain of normal attraction of a stable distribution function F. Thus, there exist a sequence of numbers a_n and a positive constant b such that, for all x, $P(X_1+\ldots+X_n - a_n \le bn^{1/\alpha}x)$ converges to $F(x)$. The number α is the so-called characteristic exponent.

In several papers the difference

$$\Delta_n = \sup_x |P(X_1+\ldots+X_n - a_n \le bn^{1/\alpha}x) - F(x)|$$

is studied. We mention, for example, papers written by Zolotarev (1962), Ibragimov (1966) and Christoph (1979). We discuss the assumptions they have made and give some new results.

References

Christoph, G. Convergence rate in integral limit theorem with stable limit law. Lithuanian Math. Journal 19 (1979) 91 - 101.

Ibragimov, I.A. On the accuracy of gaussian approximation of the distribution functions of sums of independent variables. Theor. Prob. Appl. XI (1966) 559 - 580.

Zolotarev, V.M. Analog of the Edgeworth-Cramer asymptotic expansion for the case of approximation with stable distributions. Proc. Sixth All-Union. Conf., Vilnius (1962) 49-50.

RECURSION FORMULAE FOR THE LIFETIME DISTRIBUTION OF A UNIDIRECTIONAL FIBROUS MATERIAL

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and
S. Leigh Phoenix

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We consider the chain-of-bundles model for the time-to-failure of a fibrous material under a specified load. Within each bundle the surviving fiber elements share this load according to a prescribed local load-sharing rule, and their lifetime distributions are given as functionals of their individual load histories. The fibrous material fails when the weakest bundle fails. The key result is that G_n, the distribution function for the lifetime of a bundle of n elements, can be expressed as a renewal equation in the recursive form

$$G_n = \sum_{k=1}^{n} G_{n-k} f_k + g_n,$$

where f_n and g_n are calculable sequences. Certain asymptotic results, practical conclusions and conjectures are also discussed.

Key Words: fiber bundle, local load-sharing, fatigue lifetime, composite materials

GENERAL CUMULATIVE SHOCK MODELS

Ushio Sumita
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and

George Shanthikumar
University of Arizona

In this paper we define and analyze a cumulative shock model associated with correlated pair $(X_n, Y_n)_0^\infty$ of renewal sequences. The damages caused by the shocks accumulate additively, and the system fails when the magnitude of the accumulated damage exceeds a prespecified threshold level. Two models, depending on whether the n-th shock X_n is correlated to the length Y_n of the interval since the last shock, or to the length Y_n of the subsequent interval until the next shock, are considered. The transform results and the asymptotic properties of the failure times are obtained. Further, sufficient conditions under which this system failure time is new better than used, new better than used in expectation and harmonic new better than used in expectation for these two models are given.

THE SUPREMUM OF A LINEAR SUM OF STOCHASTIC PROCESSES

S.F.L. Gallot

Applied Mathematics Division, D.S.I.R., New Zealand

In the study of loads imposed on engineering structures, the largest load in the lifetime, s, of a structure is given by

$$L(s) = \sup_{0 \le t \le s} \sum_{i=1}^{n} c_i X_i(t) \quad ,$$

where $\{c_i, i = 1,2,\ldots,n\}$ are prescribed nonnegative constants, $X_1(.)$ is a step process in time describing long-term loads and $\{X_i(.), i = 2,3,\ldots,n\}$ are intermittent processes describing short-term loads such as wind and earthquake. Processes are assumed mutually independent.

A formula is given for the distribution of $L(s)$ which has simple form when the magnitude distribution associated with $X_1(.)$ is discrete or absolutely continuous.

A CONTINUOUS STOCHASTIC PROCESS TO REPRESENT DAMAGE INITIATION AND GROWTH

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Lockheed-California Company

The proposed process represents the cumulative damage size (system state) and its growth with time. It is depicted as a staircase function where the horizontal and vertical segments are both continuous random variables. At a given time, the cumulative damage size is a continuous random variable and the time to leave a given size is also a continuous random variable. This creates a pair of complemental stochastic processes with related statistics.

A standard growth process with no unknown parameters is presented in detail. Stationarity and the Markoff property in a growth process are defined and estimation is briefly discussed.

KEYWORDS:

Continuous stochastic processes.
Staircase random functions.
Stochastic growth.

IMPULSE CONTROL OF BROWNIAN MOTION

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Consider a storage system, such as an inventory or cash fund, whose content fluctuates as a (μ,σ^2) Brownian motion in the absence of control. Holding costs are continuously incurred at a rate proportional to the storage level, and we may cause the storage level to jump by any desired amount at any time except that the content must be kept nonnegative. Both positive and negative jumps entail fixed plus proportional costs, and our objective is to minimize expected discounted costs over an infinite planning horizon. A control band policy is one that enforces an upward jump to q whenever level zero is hit, and enforces a downward jump to Q whenever level S is hit $(0 < q < Q < S)$. We prove the existence of an optimal control band policy and calculate explicitly the optimal values of the critical numbers (q,Q,S).

Key Words and Phrases

Brownian Motion, Stochastic Control, Jump Boundaries, Inventory and Production Control, Impulse Control, Stochastic Cash Management.

Monday 4:00 - 4:20

ON SWITCHING AND IMPULSIVE CONTROL

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This paper is concerned with the optimal control of a reflected diffusion in a bounded domain. The process can be controlled by impulsing the state of the process, and switching the control mode. Whithin each control mode, there is an operating cost. There are costs, incurred instantaneously, to switch the control mode, and to impulse the state of the process. An admissible strategy is a sequence of stopping times at which actions can be taken to control the process. With Bensoussan-Lions' results on optimal stopping time problems, two quasi-variational inequalities are solved as the dynamic programming equations for a discounted cost and a long run average cost criterions.

Key words: optimal control, diffusion, stopping time.

Monday 4:25 - 4:45

AVERAGE OPTIMALITY CRITERIA IN THE PROBLEMS WITH UNLIMITED CONTROL RATES

M.I. TAKSAR
Stanford University

We observe a Brownian motion process. We can increase or decrease the value of the process paying r times the size of increase and ℓ times the size of decrease. Holding costs are incurred cont'nuously at a rate $h(Z_t)$ where Z_t is the resulting process. The objective is to minimize average (per unit of time) expected cost.

It is shown that for a convex h the optimal policy is to keep the process inside a certain interval with minimal efforts. It is shown that the optimal policy can be also found by solving a special optimal stopping problem for two players with opposite interests.

Key Words: Brownian motion, optimal control, reflecting barriers, game of two players, optimal stopping

Monday 4:50 - 5:10

CONTROLLABILITY OF STOCHASTIC SYSTEMS

Wolfgang Kliemann, Forschungsschwerpunkt Dynamische Systeme

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In this talk we discuss several concepts of controllability for stochastic systems. For linear systems

$$\dot{x}(t) = A \cdot x + B \cdot u + C \cdot \xi$$

with white or colored noise ξ we derive algebraic sufficient (and in most cases also necessary) conditions for controllability in the state space $\mathbb{R}^d$ and in the space of probability measures on $\mathbb{R}^d$. For nonlinear systems

$$\dot{x}(t) = A(x) + \sum_{i=1}^{m} B_i(x) \cdot u + C(x) \cdot \xi$$

we give conditions for controllability in the state space in terms of control properties of an associated deterministic control system. In any case the criteria reduce to the well known deterministic ones in the absence of noise.

Key words : stochastic systems, controllability, diffusion processes, invariant measures

TIME REVERSAL DEPENDING ON LOCAL TIME

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The process (X,ℓ), where X is a Markov process and ℓ is its local time at a regular point b, is reversed from the time ℓ first exceeds the level t, and the resulting process is identified under duality hypotheses. The approach employs pathwise time reversal operations and excursion theory, using techniques of Getoor and Sharpe [1] and Mitro [2]. By similar methods the duality measure shared by the process and its time reversal is computed.

REFERENCES

[1] R.K. Getoor and M.J. Sharpe, Two results on dual excursions, in: E. Cinlar, K.L. Chung, R.K. Getoor, eds., Seminar in Stochastic Processes 1981 (Birkhäuser, Boston, 1981).

[2] J.B. Mitro, Exit systems for dual Markov processes, to appear, Z. Wahrsch. verw. Gebiete.

KEY WORDS: *Markov process, local time, time reversal*

SHORT TITLE: Time Reversal

ENERGY & EIGENFUNCTIONS OF TIME-INHOMOGENEOUS BROWNIAN MOTION

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The time-inhomogeneous Brownian motion, $B(g(t))$, is the ordinary Brownian motion $B(t)$, whose time t has been replaced by a continuous $g(t)$, with $g(0)=0$ and $g'(t)>0$ for $0 \leq t \leq T$. We obtain the eigenfunctions for the Karhunen-Loève expansion of $B(g(t))$ explicitely, and these are Bessel functions of the first kind with a suitable argument and order. The eigenvalues are virtually the zeros of the Bessel functions. These results allow the evaluation of the energy (or stochastic integral of the square) of $B(g(t))$, by virtue of the Karhunen-Loève expansion.

Reference : C. Maccone "Eigenfunction Expansion for the Non-linear Time Dependent Brownian Motion", in Proceedings of the N.A.T.O. Advanced Study Institute on Nonlinear Stochastic Problems (held May 16- 26, 1982, in Algarve, Portugal), to appear.

Keywords : Gaussian processes, Karhunen-Loève expansion, Bessel functions.

Tuesday 11:25 - 11:45

CONVERGENCE OF QUASI-STATIONARY DISTRIBUTIONS IN BIRTH-DEATH PROCESSES

Julian Keilson and Ravi Ramaswamy
University of Rochester

Let $(N(t))$ be an ergodic birth-death process on state space $\mathcal{N} = (0, 1, 2, \ldots\ldots)$. Let $(N^{\Delta}_{k+1}(t))$ be the associated sequence of absorbing processes on $(0, 1, \ldots, k, k+1)$ with state $k+1$ absorbing. Consider the sequence of quasi-stationary distributions q^T_k on $(0, 1, \ldots\ldots, k)$. It will be shown as a limit theorem that if , as $k \to \infty$, the mean time from state 0 to state k becomes infinite i.e. if the boundary at infinity is entrance or natural, then the sequence q^T_k converges in distribution to the ergodic distribution of $(N(t))$. We also discuss related limit theorems of interest and other structural properties of the quasi-stationary distribution for elementary Markov processes.

Tuesday 11:50 - 12:10

THE ASYMPTOTIC DISTRIBUTIONS OF RUN OCCURRENCES FOR MARKOV-DEPENDENT TRIALS

Steven J. Schwager
Cornell University

In a stationary L-order Markov dependent process with v states and n trials, a run R is any specified sequence of k states. The probabilities that R first occurs at trial m and that R occurs at or before trial n are functions of the composition of R, the transition probabilities, and the number of trials. This paper treats the large-sample behavior of the number of occurrences of R in n trials and the number of trials up to and including the r^{th} occurrence of R, using renewal theory and generating functions related to recurrence times. Practical applications are discussed.

Keywords: Multiple Markov dependence; Runs distributions.

BIASED COIN DESIGNS AND MARTINGALES

Richard L. Smith

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Patients are assigned at random to two treatments. If there are n_i patients on treatment $i (i = 1, 2)$ then the $(n_1 + n_2 + 1)$'st patient is assigned to treatment 1 with probability $n_2^\rho/(n_1^\rho + n_2^\rho + 1)$ independently of the past, otherwise to treatment 2. Here ρ is a positive parameter. This may be taken as the prototype of a general class of "biased coin designs" whose purpose is to improve the balance of the experiment (compared with the "completely random" case $\rho = 0$) whilst retaining randomisation. Wei (Ann. Statist. 6, 92-100, 1978) showed that the proportion of patients on treatment 1 is asymptotically normally distributed with variance proportional to $1/(1 + 2\rho)$. I shall give an alternative proof of Wei's result based on the martingale central limit theorem. The new approach allows many generalisations of Wei's result. The whole approach may be extended to $k > 2$ treatments or assignment rules which take account of covariate information.

STATE ESTIMATION FOR COX PROCESSES WITH UNKNOWN PROBABILITY LAW

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Let N_i be i.i.d. observable Cox processes on a compact metric space E, directed by unobservable random measures M_i, whose law is entirely unknown. Techniques are presented for approximation of state estimators $E[\exp(-M_{n+1}(f)) \mid \mathcal{F}^{N_{n+1}}]$ using data from $N_1, \ldots, N_n$ to estimate necessary attributes of the unknown law of the M_i. The techniques are based on representation of the state estimator in terms of reduced Palm distributions of the N_i and estimation of these Palm distributions. The difference between the true state estimator and the pseudo-state estimator converges to zero in L^2 at rate $n^{-\frac{1}{2}+\delta}$, $\delta > 0$, as $n \to \infty$.

Short title: State Estimation for Cox Processes

Key words and phrases: Cox processes, point process, Palm distribution, estimation for point processes, state estimation.

Tuesday 11:25 - 11:45

TWO-DIMENSIONAL PROJECTION PURSUIT TESTS FOR GOODNESS OF FIT AND EQUALITY OF DISTRIBUTIONS

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By a "projection pursuit test" we mean an extension of a one-dimensional test in which the statistic is $\max_t T(t)$, $T(t)$ being the test statistic for the projection of the data on the line through the origin in the direction t. We construct two such tests here. One for the goodness of fit to the distribution F_0 and another for equality of two distributions F and G. To study the properties of these tests, we prove the weak convergence of the process $\{T(t) - T(0);\ 0 \leq t \leq \pi\}$ to a diffusion process. This allows us to find the level of significance for these tests and show their consistency.

Short title: Prop-Tests

Keywords: Projection pursuit, two-dimensional tests, weak convergence of stochastic processes, diffusion process.

Tuesday 11:50 - 12:10

CONFIDENCE INTERVALS FOR DEMOGRAPHIC PROJECTIONS

C.C. Heyde

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Canberra, Australia

This talk will be concerned with assessing the growth of age structured populations whose vital rates vary stochastically in time and in particular with the provision of confidence intervals for population growth. Models of the kind

$$Y_{t+1}(\omega) = X_{t+1}(\omega)Y_t(\omega)$$

and

$$Y_{t+1}(\omega) = X_{t+1}(\omega)Y_t(\omega) + \varepsilon_t(\omega)$$

will be discussed where Y_t is the (column) vector of the numbers of individuals in each age class at time t, X is a matrix of vital rates, ε_t is a stochastic disturbance whose expectation is zero and ω refers to a particular realization of the process that produces the vital rates. It is assumed that $\{X_i\}$ is a stationary sequence of random matrices with nonnegative elements.

HIDA TYPE MULTIPLICITY REPRESENTATION FOR p-STABLE STOCHASTIC PROCESSES

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An analogue of Hida canonical representation of Gaussian processes is obtained for a class of symmetric p-stable (SpS) processes, $1<p<2$. Any left-continuous, purely nondeterministic SpS-stochastic process X_t which admits independent projection property can be expressed in the form

$$X_t = \sum_{n=1}^{N} \int_{-\infty}^{t} g_n(t,u)\,dY^n(u) \quad , \quad -\infty<t<+\infty \ ,$$

where $(Y^n(u))$ $u \in \mathbb{R}$ are mutually independent SpS processes with independent increments and $\forall t \in \mathbb{R}$ $g_n(t,u) \in L^p(G_n(u))$. Here the spectral functions $G_n(t) = [Y^n(t), Y^n(t)]_p$, where $[\cdot,\cdot]_p$ is the covariation of two SpS random variables (see S. Cambanis & G. Miller, SIAM J. Appl. Math. 41, (1981), 43-69), satisfy the partial ordering relation of absolute continuity: $G_1 > G_2 > \ldots > G_N$.

In contrast with the Gaussian case, purely nondeterministic stable processes which are Fourier transforms of processes with independent increments, has no multiplicity representation.

Keywords: symmetric p-stable process, canonical representation, multiplicity representation, independent projection.

Short title: Multiplicity representation for stable processes.

INVARIANCE PRINCIPLE FOR SYMMETRIC STATISTICS

A. Mandelbaum and M.S. Taqqu
Cornell University

We derive invariance principles for processes associated with symmetric statistics of arbitrary order. Using a Poisson sample size such processes can be viewed as functionals of a Poisson Point Process. Properly normalized, these functionals converge in distribution to functionals of a Gaussian random measure associated with the distribution of the observations. We thus obtain a natural description of the limiting process in terms of multiple Wiener integrals. The results are used to derive asymptotic expansions of processes arising from arbitrary square integrable U-statistics.

Tuesday 11:25 - 11:45

ON THE DECOMPOSITION OF A TWO-PARAMETER MARTINGALE

D. Nualart
Universitat de Barcelona

Suppose that $\{M_{st},\ (s,t) \in R_+^2\}$ is a two-parameter square-integrable continuous martingale, with respect to an increasing family of σ-fields satisfying the usual conditions of Cairoli and Walsh (cf. [1]). Then, assuming that M vanishes on the axes, the following decomposition holds

$$M_{st}^2 = 2 \int_0^s \int_0^t M_z dM_z + 2 \tilde{M}_{st} + \langle M_{.t} \rangle_s + \langle M_{s.} \rangle_t + \langle M \rangle_{st} .$$

The first two terms of this expression are continuous martingales, the processes $\langle M_{.t} \rangle_s$ and $\langle M_{s.} \rangle_t$ are the quadratic variations of M in one coordinate and they have continuous versions in (s,t), and, finally, $\langle M \rangle_{st}$ is a continuous version of the quadratic variation of M. As a generalization of this decomposition, one can prove an Itô's differentiation formula for continuous martingales bounded in L^4, which is analogous to the formula obtained by Chevalier in [2].

References.

[1] CAIROLI, R. and WALSH, J.B. (1975). Stochastic integrals in the plane. Acta Math. 134, 111-183.

[2] CHEVALIER, L. (1982). Martingales continues à deux paramètres. Bull. Sc. Math., 2e série, 106, 19-62.

Key words: Two-parameter martingales. Quadratic variation.

Tuesday 11:50 - 12:10

STOCHASTIC INTEGRALS ON GENERAL TOPOLOGICAL MEASURABLE SPACES

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A general theory of stochastic integral in the abstract topological measurable space is established. The martingale measure is defined as a random set function having some martingale property. All square integrable martingale measures constitute a Hilbert space M^2. For each $\mu \in M^2$, a real valued measure $\langle \mu \rangle$ on the predictable σ-algebra ρ is constructed. The stochastic integral of a random function $h \in L^2(\langle \mu \rangle)$ with respect to μ is defined and investigated by means of Riesz's theorem and the theory of projections. The stochastic integral operator I_μ is an isometry from $L^2(\langle \mu \rangle)$ to a stable subspace of M^2, its inverse is defined as a random Radon-Nikodym derivative. Some basic formulas in stochastic calculus are obtained. The results are extended to the case of local martingale and semi-martingale measures as well.

Short title: Stochastic Integrals on Abstract Spaces.

Key words and phrases: stochastic integral, martingale measure, predictable σ-algebra, Doléans measure, projection, random Radon-Nikodym derivative, stable subspace.

References: [1] M. Métivier, Lect. Notes in Math. 607 (1977); [2] Z. Huang, Wuhan Univ. J. special issue of Math. I (1981)pp.89-101.

Tuesday 12:15 - 12:35

SAMPLE PATH VARIATION OF SELF-SIMILAR PROCESSES WITH STATIONARY INCREMENTS

by WIM VERVAAT

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A process $X = (X(t))_{t\in[0,\infty)}$ is self-similar with exponent H (H-ss) if the finite-dimensional distributions of $a^{-H}X(a.)$ are the same for all $a > 0$. In [1] it was proved that, apart from trivial cases, H-ss processes with stationary increments can have sample paths of locally bounded variation for $H > 1$, but not for $0 < H \leq 1$. Here we present a new and instructive proof that will be part of the revision of [1]. It is based on a confrontation between the two following observations (for $n \to \infty$).

(1). By self-similarity, $n^{-1}X(n)$ converges in distribution to some $[-\infty,\infty]$-valued random variable.

(2) If $EX(1)$ exists (finite or infinite), then by Birkhoff's ergodic theorem applied to stationary increments:

$$n^{-1}X(n) \to E^{\mathcal{J}}X(1) \text{ wp1 ,}$$

where the limit is the conditional expectation of X(1) given the σ-field $\mathcal{J}$ of events that are invariant under the shift of $(X(k)-X(k-1))_{k=1}^{\infty}$.

Reference

[1] W. VERVAAT (1982): Sample path properties of self-similar processes with stationary increments. Technical Report 545, School of Operations Research and Industrial Engineering, Cornell University.

Keywords: self-similar process; stationary increments; sample paths of locally bounded variation; Birkhoff's ergodic theorem.

Short title: Self-similar sample path variation.

Thursday 11:00 - 11:20

INTEGER-VALUED SELF-SIMILAR PROCESSES

F.W. Steutel

Eindhoven University of Technology, The Netherlands

We consider $\mathbb{N}_0$-valued processes $X(t)$ with $X(0)=0$ almost surely that are discrete self-similar, i.e. satisfying

(1) $$X_{at} = a^{H} \odot X_t \qquad (0<a\leq, t>0)$$

where $\odot$ denotes the multiplication defined in [1].

It turns out that one has a choice in defining (1) with respect to higher dimensional marginals, and that dependent on that choice the discrete self-similar processes are of the form $N(Y_t)$ or $N_t(Y_t)$, where $N(\cdot)$ and $N_t(\cdot)$ are (independent) compound Poisson processes related to branching processes, and Y_t is a self-similar process in the classical sense.

As a special case, the Poisson processes are discrete self-similar with exponent 1.

[1] K. van Harn, F.W. Steutel and W. Vervaat, Self-decomposable discrete distributions and branching processes, Z. Wahrscheinlichkeitstheorie verw. Gebiete 61, 97-118 (1982).

Keywords: discrete self-similar, compound Poisson, branching process.

Short title: Discrete self-similarity.

MODELING HIGH VARIABILITY AND LONG-RUN DEPENDENCE THROUGH THE USE OF RENEWAL SEQUENCES

Joshua Levy
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We investigate the limiting behavior of the normalized sums of two random processes $W=W(t)$ and $V=V(t)$, $t \in \{..., -1,0,1,...\}$. $W(t)$ is a stationary process with large inter-renewal intervals, while $V(t)$ takes the value zero except at some rare instants t where it achieves extremely high values. For $T>0$, these sums are defined by

$$W^*(T,M) = \sum_{t=1}^{T} \sum_{m=1}^{M} W_m(t), \quad V^*(T,M) = \sum_{t=1}^{T} \sum_{m=1}^{M} V_m(t),$$

where W_m and V_m are i.i.d. copies of W and V. We study W^* and V^* for $T>>M$, $M>>T$, and T and M diverging arbitrarily. In an economic context, T denotes time, M is a model index, and W^* and V^* are commodity prices.

Key Words: renewal sequence, high variability, long-run dependence, fractional Brownian motion, Lévy stable process.

Thursday 11:50 - 12:10

A SPECTRAL REPRESENTATION FOR STATIONARY MIN-STABLE STOCHASTIC PROCESSES

L. de Haan, Erasmus University Rotterdam

and

J. Pickands III, Erasmus University Rotterdam and University of Pennsylvania

Suppose we have an i.i.d. sequence of stochastic processes $\{X_n(t)\}_{t\in T}$ ($n = 1, 2, \ldots$). Consider $M_n(t) := \bigwedge_{k=1}^{n} X_k(t)$ for $t\in T$. Suppose for some sequence $\{c_n\}$ of positive constants the processes $\{c_n^{-1}M_n(t)\}_{t\in T}$ converge in distribution, as $n\to\infty$, to a stochastic process $\{Z(t)\}_{t\in T}$. We describe this process as follows: imagine a homogeneous Poisson point process P on $[0,1] \times \mathbf{R}_+$. There are non-stochastic functionals ψ_t of the process P such that $\{Z(t)\}_{t\in T} \overset{d}{=} \{\psi_t(P)\}_{t\in T}$. This spectral representation is then considered in the context of strict stationarity. A Dobrushin type result holds for the sample paths in the continuous time stationary case. Other extreme order statistics are considered as well.

Keywords: extreme order statistics, spectral representation, stationarity.

Short title: Min-stable processes

Thursday 12:15 - 12:35

The Waiting Time Structure of M/G/1 Queueing Systems in Tandem

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We consider two M/G/1 queueing systems in tandem, A and B. The service times T_A and T_B are independent and both systems have unlimited waiting rooms. It will be shown that, when $T_A \leq T_B$ a.s., the total waiting time $W_k = W_{Ak} + W_{Bk}$ of the k-th customer is Markov and is a Lindley process with a readily accessible ergodic distribution. Conditions under which methods lead to a good approximation when the condition $T_A \leq T_B$ a.s. is not present will be discussed. The result extends to multiple M/G/1 queueing systems in tandem under similar conditions.

EXPLICIT WIENER-HOPF FACTORIZATIONS IN THE THEORY OF QUEUES

Jos H.A. de Smit
Twente University of Technology
Enschede, The Netherlands

Systems of Wiener-Hopf-type equations occur frequently in queueing theory and related problems. Most emphasis has been on finding Wiener-Hopf factors which have a probabilistic meaning, but usually it is not clear how these factors can be calculated explicitly in order to obtain numerical results even for rather special cases. Spitzer's identity is a classical example of such a factorization. It turns out that for many queueing models explicit factorizations can be given which lead to powerful and efficient numerical methods. As examples we discuss the solution for the model $GI|H_m|s$ and a $M|G|1$ queue in which arrival rates and service times depend on the state of an underlying finite Markov chain.

WIENER-HOPF FACTORIZATION, QUEUES, NUMERICAL METHODS

Thursday 11:25 - 11:45

New Results for the Jackson Network

William A. Massey
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Using operator methods, we prove a general decomposition theorem for Jackson networks. For its transient joint queue length distribution, we can stochastically bound it above by a network that decouples into smaller independent Jackson networks.

We can also extend Jackson's theorem to completely characterize the large time behavior of any Jackson network. In particular, for a network that is not ergodic, we can determine the maximal subnetwork that achieves steady state, and compute its limiting distribution. This is achieved by formulating and solving a new non-linear throughput equation.

Keywords: Transient behavior, Stochastic domination, Non-ergodic networks, New throughput equation

Thursday 11:50 - 12:10

THE SLOW SERVER PROBLEM

Michael Rubinovitch
Northwestern University

The slow server problem is what to do with a slow server in a multiserver service facility which has fast and slow servers. Is it better to remove the slow server and operate the system with a smaller number of servers, or should the slow server be used to render service, and then increase the time that some customers spend in the system? The terms "slow" and "fast" are used in the sense of mean service time. Simple models are formulated to answer this question and some qualitative and quantitative results on the optimum policy are given.

Thursday 12:15 - 12:35

GITTINS INDICES IN THE DYNAMIC ALLOCATION PROBLEM FOR DIFFUSION PROCESSES

Ioannis Karatzas
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We discuss the problem of allocating effort among several competing projects, the states of which evolve according to one-dimensional diffusion processes. It is shown that the "play-the-leader" policy of continuing the project with the leading Gittins index is optimal, and very explicit computations of the index are offered. The question of constructing the diffusions according to the above policy is also addressed.

Key words and phrases: Stochastic control, optimal stopping, variational inequalities, dynamic allocation, Gittins index, play-the-leader rule, diffusion processes.

Thursday 11:00 - 11:20

ON PRESERVING THE RESERVATION WAGE PROPERTY IN A CONTINUOUS SEARCH MODEL

Dror Zuckerman
The Hebrew University of Jerusalem, Israel

The purpose of this article is to examine a continuous model of job search. Job offers are received randomly over time according to a renewal process. The wage offers are assumed to be positive, independent and identically distributed random variables. There is a search cost of c monetary units per unit time. The only decision the searcher must make is when to stop searching and accept an offer. We show that the optimal stopping strategy over the class of all stopping times possesses the reservation wage property, provided that the inter-arrival time between two successive job offers is NBUE (New Better than Used in Expectation).

KEY WORDS

Stopping time, Job search, renewal process, reservation wage

THE e^{-1} - LAW IN BEST CHOICE PROBLEMS

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This communication displays a unified approach to a class of Optimal Choice Problems under total ignorance of the candidates' quality distribution. We shall call it "e^{-1}-law" because of the multiple role this number plays in a more general context as in the solution of the classical Secretary Problem [1]. The unificafion is obtained for the class of Optimal Choice Problems which can be redefined as continuous time decision-problems on conditionally independent arrivals. Optimal stopping times change into optimal waiting times which prove to be more tractable and show that some solutions of Best Choice Problems (see e.g. [2], [3]) can be "improved" by a more general concept of optimality.

[1] E.B. DYNKIN, A.A. JUSCHKEWITSCH : "Sätze und Aufgaben Über Markoffsche Prozesse", Springer Verlag 1969.

[2] E.L. PRESMAN, I.M. SONIN : "The Best Choice Problem for a Random Number of Objects", Theor. Prob. Appl. 17, pp. 657-668, 1972.

[3] W.T. RASMUSSEN, H. ROBBINS : "The Candidate Problem with Unknown Population Size", J. Appl. Prob. 12, pp. 692-701, 1975.

Keywords : Secretary Problem, Optimal Stopping Time, Conditional Independence.

MACHINE MAINTENANCE AND OPTIMAL STOPPING

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Two closely related problems are studied in a Markov decision theoretic framework. The first problem is a machine maintenance problem. The state of deterioration of the machine is denoted by $i \in \{0,1,2,\ldots,\}$. Inspecting the machine costs I dollars and reveals the state of the machine. The decision to either replace the machine or not to replace it is to be taken based on this information. Replacement costs R dollars and running the machine in state i costs $c(i)$ dollars. If decision is made not to replace the machine, the next inspection must be scheduled after some optimal time. This is what makes our model different from the others in the literature.

The second problem is a variation of the optimal stopping problem. Upon observing the system in state i , if the decision is to stop, it costs $f(i)$ dollars; if the decision is to continue then the next observation time must be scheduled in an optimal way, since observing the system costs I dollars and time spent between observations costs c dollars per unit time.

It is shown that there exist deterministic inter-observation times which are optimal in the above problems. Thus random schedules need not be considered. Sufficient conditions are derived under which the optimal policy has a simple form.

ON THE "PHASE TRANSITION" IN A BRANCHING RANDOM WALK

Richard Durrett

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Consider the (discrete time) branching random walk in which a particle at x independently gives birth to particles at $x+1$ and at $x-1$ with probability p. It is well known that this system has a critical probability $p_c = 1/2$ i.e. if $p < 1/2$ the branching process is subcritical and if $p > 1/2$ it is supercritical. In this talk we will study the limiting behavior of $Z_n(x)$ = the number of particles at x at time n, and focus in particular on how these limiting quantities vary as p approaches p_c. The results we will prove are analogues of theorems we would like to prove for oriented percolation.

Thursday 11:00 - 11:20

MULTIVARIATE DEPENDENT RENEWAL PROCESSES

Eric Slud

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A new class of reliability point-process models for dependent components is introduced. The dependence is expressed through a regression, following a form suggested by Cox (1972) for survival data analysis involving the current life-length of the components. After formulating the current-life process as a Markov process with stationary transitions and stating some general results on asymptotic behavior, we describe the stationary distributions in some bivariate examples. Finally, we discuss statistical inference for the new models, exhibiting and justifying full- and partial-likelihood methods for their analysis.

Key words: multivariate renewal process, dependent components, Markov process, reliability theory, partial likelihood.

Thursday 11:25 - 11:45

MARKOV CHAIN RETURN TIMES ATTRACTED TO A STABLE LAW

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Consider a null-recurrent, aperiodic Markov chain $\{X_n, n \geq 0\}$ on the integers and let T be the time of first return to the origin. Suppose T is attracted to a stable law of index α, $0<\alpha<1$. Garsia and Lamperti (A discrete renewal theorem with infinite mean--Comm. Math. Helvet., 37 (1963), 221-234) proved that if

(1) $\frac{1}{2}<\alpha<1$

then the sequence $u_n = P(X_n=0 \mid X_0=0)$ satisfies the local limit law

(2) $\lim_{n\to\infty} n^{1-\alpha}L(n)\, u_n = C$, C constant

where $L(n)$ is slowly varying. We prove that (2) holds if (1) is replaced by

(1') there is a fixed integer $k \geq 1$ such that the sequence $\{u_{nk}\}$ is monotone non-increasing.

(1') is known to hold, e.g., for reversible chains. We also prove that if (2) holds for the type of chain specified in the first sentence above, then T is attracted to a stable law of index α, $0<\alpha<1$.

KEYWORDS: Markov chain, stable law, slowly varying function, Tauberian theorems.

Thursday 11:50 - 12:10

TRIVARIATE DENSITY OF BROWNIAN MOTION, ITS LOCAL AND OCCUPATION TIME, WITH APPLICATION

Ioannis Karatzas
Columbia University

Steven Shreve
Carnegie-Mellon University

We compute the joint density of Brownian motion, its local time at the origin, and its occupation time of the positive half-line. We use the result to compute the transition probability of the optimal process in an asymmetric bang-bang control problem.

Thursday 12:15 - 12:35

LEVEL-CROSSING PROBABILITIES FOR RANDOM PROCESSES AND SUPREMUM DISTRIBUTIONS FOR RANDOM FIELDS: OVERVIEW AND RECENT RESULTS

Julia Abrahams
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Office of Naval Research, Arlington, VA 22217

The probability distribution of the first time a random process reaches a fixed value is closely related to the distribution of the maximum of the process over an interval of time. First-passage-time problems are not meaningful for fields, processes with multi-dimensional time parameters, but the problem of finding the distribution of the supremum of a field over some region of its parameter space continues to be of interest. Few explicit results are known for problems of these types. A discussion of known results and the limitations of the methods used will serve to motivate interest in a new result for the supremum distribution of the two-parameter Slepian process on the boundary of the unit square.

Thursday 4:00 - 4:20

THE PARALLEL REALIZATION OF MARKOV RANDOM FIELDS WITH APPLICATIONS TO PROBLEMS IN INFERENCE AND OPTIMIZATION

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We propose a Markov Random Field (MRF) model and a corresponding simulation scheme for certain optimization problems that arise in very large spatial systems of interacting sites, such as those encountered in digital image processing, the travelling salesman problem, and a new approach to medical diagnosis. The simulation algorithms are model-based and used for "sampling", parameter estimation, and statistical inference as well as optimization. In the latter, a quantity of interest (e.g. a "true scene" or "minimal tour") is associated with the configuration of maximal probability (= lowest energy) for an appropriate MRF. Separate processors are placed at the sites and linked in accordance with the MRF graph structure. Equilibrium is reached by "annealing" (reducing temperature) and "relaxation", which refers to site replacements based on the local characteristics of the MRF.

Thursday 4:25 - 5:05

LOCALLY INTERACTING MARKOV PROCESSES AMENABLE TO PARALLEL UPDATING

Toby Berger and Flavio Bonomi

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Some Markov local interactions are amenable to rapid updating by means of parallel processing arrays. We consider a certain family of such processes with a finite number of locally interacting components that combine features of both synchronous and asynchronous systems in Dawson's (1) terminology. We show that they are ergodic, that their invariant measures are first order Markov random fields, and that they are not time-reversible. Convergence properties, an extension to countably many components, and applications to simulation of multidimensional lattice gas models are treated.

Key words: Markov local interactions, Markov random fields, parallel processing, generalized Ising model simulation.

(1) D. A. Dawson, "Synchronous and asynchronous reversible systems." Canadian Math. Bull., 17, 633-649, 1975.

Thursday 5:15 - 5:35

IMMUTABLE RANDOM PROCESSES, POLYA'S THEOREM, AND LOCAL TIME

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A random process $\{X_t\}$ is designated immutable if the normalized autocovariance of $\{Y_t = g(X_t)\}$ is the same as that of $\{X_t\}$ for any nondegenate function $g: \mathbf{R} \to \mathbf{R}$. The problem of synthesizing a stationary immutable random sequence with specified autocovariance function and first-order distribution is treated. Given any Polya-type characteristic function $\rho(\tau)$ (i.e. $\rho(0) = 1$, $\rho(-\tau) = \rho(\tau)$, $\rho(\tau)$ convex downward for $\tau \geq 0$, and $\rho(\tau) \to 0$ as $\tau \to \infty$), we construct a second-order strictly stationary renewal process that is immutable and has $\rho(\tau)$ as its normalized autocovariance function. Since the proof is constructive, it provides an alternative means of establishing Polya's theorem. In order to encompass the cases in which $\rho'(\tau) \to -\infty$ as $\tau \downarrow 0$, we invoke the Horowitz-Cinlar characterization of the generalization to local time of the distribution of backward and forward recurrence times.

Key words: Renewal processes, local time, Polya's theorem, immutable processes.

Thursday 4:00 - 4:20

RENEWAL THEORY WITH PERIODIC TIME-DEPENDENCE

Hermann Thorisson

Chalmers University of Technology, Sweden

Many real-world phenomena developing in a varying environment are modeled as being time-homogeneous. While often the time-dependence is too strong for the assumption of time-homogeneity to be realistic, it sometimes is quite natural to suppose that the time-dependence is periodic. In this talk we present the results of [1]. These are mainly straightforward extensions of well-known results from classical renewal theory (Blackwell's theorem, the key renewal theorem, the ergodic theorem for regenerative processes) and of more recent developments in that field (total variation convergence, rates of convergence). The starting point is the observation that under a certain nonsingularity condition the problem of periodic time-dependence can be reduced to that of time-homogeneity.

KEY WORDS: RENEWAL PROCESS; MARKOV CHAIN; REGENERATIVE PROCESS; PERIODIC TIME-DEPENDENCE.

Reference:

[1] Thorisson, H. (1983), Periodic Renewal Theory. Report, Dept. of Math., Göteborg.

Thursday 4:25 - 4:45

RANDOM WALKS ON TOPOLOGICAL INVERSE SEMIGROUPS

Patricia Cerrito
University of South Florida

Much work has been done in recent years to generalize the various aspects of probability theory to abstract algebraic structures. In the semigroup structure, most of the work has been restricted to those semigroups which were compact or completely simple. The author considers random walks on inverse semigroups; in particular, discussing essential states and recurrence.

KEYWORDS: Random Walk, Inverse Semigroups

Thursday 4:50 - 5:10

LARGE DEVIATION PROBABILITIES FOR OCCUPATION TIMES OF A SYSTEM OF NON-INTERACTING RANDOM WALKS

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Syracuse University
Syracuse, N.Y. 13210

and

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Mathematics Department
University of Wisconsin
Madison, WI 53706

Let ξ_t be a system of independent non-interacting simple continuous time random walks on Z^d, started at $t=0$ with an independent Poisson (mean θ) number of walks at each $x \in Z^d$. The occupation time density of a finite set $A \subset Z^d$ is $D_t = (t|A|)^{-1} \sum_{x \in A} \int_0^t |\xi_s(x)| ds$. It is known that $E D_t = \theta$ and $\text{Var } D_t \sim \sigma_d^2 a_t^{-1}$, where $a_t = t$ for $d \geq 3$, $= t/\log t$ for $d=2$, $= \sqrt{t}$ for $d=1$.

We investigate large deviation probabilities for D_t. In particular we show that for $0 < \alpha < \infty$, $\alpha \neq \theta$ there exists $I(\alpha)$, $0 < I(\alpha) < \infty$ such that

$$\lim_{t \to \infty} a_t^{-1} \log P(D_t > \alpha) = -I(\alpha) \quad , \quad \theta < \alpha < \infty$$

$$\lim_{t \to \infty} a_t^{-1} \log P(D_t < \alpha) = -I(\alpha) \quad , \quad 0 < \alpha < \theta$$

This extends recent work of Spitzer, and provides examples of "fat" large deviation probabilities, due to strong dependence among the variables D_t.

Key words and phrases: occupation times, random walk systems, large deviation probabilities.

Thursday 5:15 - 5:35

INVENTORY SYSTEMS OF PERISHABLE COMMODITIES

David Perry

Technion, Haifa, Israel

We consider inventory system in which the items stored have finite life times. The arrival of items into the system and the demand for these items are assumed to be independent poisson processes. When a demand occurs, and there are items in the system, the demand is satisfied immediately by the oldest item, otherwise it leaves the system unsatisfied. An item which is not taken by a demand during its lifetime, which is to be constant, leaves the system.

We establish a connection between the age of the oldest item in the system and the virtual waiting time of an impatient customer in an M/G/1 queueing system. This connection is the main tool in the analysis of the stochastic behaviour of this model.

Keywords: Poisson Process, lifetime, virtual waiting time, up-crossing, stopping time, optimal sampling theorem of Martingales.

Thursday 4:00 - 4:20

CONTINUITY PROPERTIES OF DECOMPOSABLE PROBABILITY MEASURES ON EUCLIDEAN SPACES

Stephen James Wolfe
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Let μ be a probability measures defined on R^k and let L be a non-singular linear operator on R^k. The probability measure μ is said to be L decomposable if $\mu = L\mu * \gamma$ for some probability measure γ. It is shown that every full e^A decomposable probability measure on R^k, where A is a linear operator all of whose eigenvalues have negative real part, is either absolutely continuous with respect to Lebesgue measure or continuous singular with respect to Lebesgue measure. This result is used to characterize the continuity properties of random variables that are limits of solutions of certain stochastic difference equations.

Thursday 4:25 - 4:45

POWER BIAS IN MAXIMUM ENTROPY SPECTRAL ANALYSIS

Juan J. Egozcue

Jaume Pagés

Universidad Politécnica de Barcelona, Spain

Several algorithms have been used in maximum entropy spectral analysis. Among them, the standard Burg's method (1975), - least squares method (Nuttall 1976, Ulrych-Calyton 1976) and - the maximum likelihood-maximum entropy method (Burg et al 1982).

When the autoregressive (AR) model, which is implicit in - theese estimation methods, is used to simulate the analyzed - process, the power or variance of the simulation can differ - from power estimated on the signal in several orders of magnitude. This is specially dangerous in engineering simulated studies about the maxima of certain parameters.

Burg's method, although not optimal in least squares sense, produces AR modeles with unbiased power, while least squares - method sometimes do not.

Step-down Levinson recurrence may be used to correct the - power bias when it is present.

Very large AR models produce a severe decrease of the simulation's power in the Burg's and least squares methods. Maximum likelihood-maximum entropy method seems to be free of this overfitting effect.

References:

J.P. Burg, "Maximum Entropy Spectral Analysis", Ph. D. Thesis, Standford U., California, U.S.A., 1975.

A.H. Nuttall, "Spectral Analysis of a Univariate Process with Bad Data Points, via Maximum Entropy and Linear Predictive - Techniques", Naval Underwater System Center Technical Paper - 5503, March, 1976.

T.J. Ulrych and R.W. Clayton, "Time Series Modelling and Maximum Entropy", Phys. Earth Planet. Interiors, 12, 188-200, 1976.

J.P. Burg, D.G. Luenberger and D.L. Wengen, "Estimation of - Structured Covariance Matrices", Proc. IEEE, 70, 9, 063-974, - 1982.

Thursday 5:15 - 5:35

CONJUGATE DISTRIBUTIONS AND VARIANCE REDUCTION IN RUIN PROBABILITY SIMULATION

Soren Asmussen
Institute of Mathematical Statistics, Denmark

A general method is developed for giving simulation estimates of the probability $\psi(u,T)$ of ruin before time T. When the probability law P governing the given risk reserve process is imbedded in an exponential family (P_θ), one can write $\psi(u,T) = E_\theta R_\theta$ for certain random variables R_θ given by the fundamental identity of sequential analysis. Using this to simulate from P_θ rather than P, it is possible not only to overcome the difficulties connected with the case $T=\infty$, but also to obtain a considerable variance reduction. It is shown that the solution of the Lundberg equation determines the asymptotically optimal value of θ in heavy traffic when $T=\infty$, and some results guidelining the choice of θ when $T<\infty$ are also given. The potential of the method in complex models is illustrated by two examples.

Risk reserve process; ruin probability; simulation; conjugate distributions; importance sampling; heavy traffic; fundamental identity of sequential analysis; Lundberg equation.

THE RESIDUAL PROCESS FOR NON-LINEAR REGRESSION

Ian B. MacNeill and V.K. Jandhyala

The University of Western Ontario
Londona, Canada

MacNeill (1978(a), 1978(b)) derived limit processes for sequences of partial sums of linear regression residuals, examined their properties and discussed their use in testing for parameter changes at unknown times. In this paper, limit processes for sequences of partial sums of non-linear regression residuals are obtained under assumptions on regressor functions imposed by Jennrich (1969). Limit processes and covariance kernels for the non-linear case are parameter dependent, which is not so when linearity is assumed. Further, the limit process and covariance kernel are calculated explicitly for functions of exponential type.

References

[1] Jennrich, R.I. (1969): Ann. Math. Statist. 40, 633-643.

[2] MacNeill, I.B. (1978a): Ann. Statist. 6, 422-433

[3] MacNeill, I.B. (1978b): Ann. Prob. 6, 695-698.

Thursday 4:00 - 4:20

ALMOST SURE DECAY RATES FOR NORMS OF WEIGHTED EMPIRICAL DISTRIBUTIONS

V. Goodman and A. Ralescu

Indiana University
Bloomington, Indiana

Under certain assumptions concerning weak second moments of a mean zero vector valued random walk, S_n, an integral test is obtained for the condition that $\{a_n\}$ be an outer (inner) sequence. That is,

$$\overline{\lim_n} \frac{1}{a_n} \|S_n\| = 0 \quad (>0) \quad \text{almost surely.}$$

This result is used to study rates of decay for the $L^p(0,1)$ norm, $2 \le p < \infty$, of weighted empirical distributions. Necessary and sufficient conditions for decay rates of such statistics are obtained in terms of the weight functions.

KEYWORDS: empirical processes, von-Mises statistic, law of iterated logarithm.

Thursday 4:25 - 4:45

AD-A136 626 CONFERENCE ON STOCHASTIC PROCESSES AND THEIR APPLICATIONS (12TH) JULY 11-15 1983 ITHACA NEW YORK(U) CORNELL UNIV ITHACA NY 15 JUL 83 2/3

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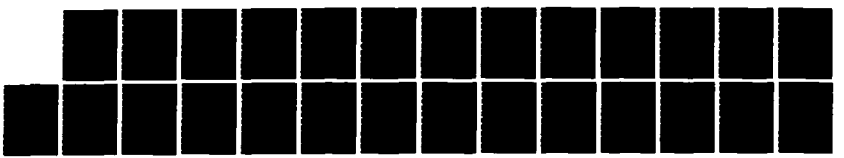

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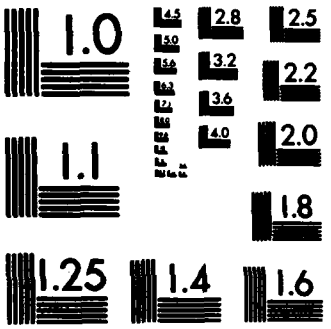

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

CHARACTERIZATIONS OF BROWNIAN AND POISSON WHITE NOISES

Yoshifusa Ito
Nagoya University

Izumi Kubo
Hiroshima University

Since Hida introduced the concept of generalized Brownian functionals, he and his colleagues have studied them extensively. The Poisson counterpart has been studied by Y.Ito. Most of the results are similar in both, but the multiplication operators have different expressions in the respective cases:

$$\dot{B}(t) = \partial_t^* + \partial_t \qquad \text{(Kubo and Takenaka)},$$

$$\dot{P}(t) = (\partial_t^* + 1)(\partial_t + 1) \qquad \text{(Ito, Ito and Kubo)},$$

where ∂_t is Hida's differential operator and ∂_t^* is its dual defined by Kubo and Takenaka. These expressions actually characterize Brownian and Poisson white noises respectively.

BROWNIAN WHITE NOISE, POISSON WHITE NOISE, DIFFERENTIAL OPERATOR, MULTIPLICATION OPERATOR, CHARACTERIZATION OF WHITE NOISE

Short title: CHARACTERIZATIONS OF NOISES

Thursday 4:50 - 5:10

PARAMETER DEPENDENCE OF LYAPUNOV CHARACTERISTIC NUMBERS

Volker Wihstutz
Universität Bremen

Noise effects the stability properties of parameter excited systems in very different ways: neutral behavior occurs as well as destabilizing impact or even averaging out the unstable modes.
These effects can be read off from the Lyapunov characteristic number

$$\lambda(\beta,\sigma) = \int q(\eta,\varphi;\ \beta,\sigma)\ \mu(d\varphi,d\eta;\ \beta,\sigma)\ ,$$

represented as the mean of a certain quadratic form $q(\eta,\varphi)$ with respect to the invariant measure of the pair (η,φ) - the noise and the angle of the state - , given the system and noise parameters β and σ.

In order to get more insight into the interplay of the system and the noise we are interested in expanding λ in terms of the parameters. For the random 1-dimensional Schrödinger operator the expansion and explicit formulars are given at typical prameter points.

Key words: Stochastic dynamical systems, random 1-dimensional Schrödinger operator, Lyapunov characteristic numbers, expansion of invariant measures .

Thursday 5:15 - 5:35

A STRONG LAW AND MIXING RATES

H.C.P. Berbee
Mathematical Centre, The Netherlands

It is well-known that necessary and sufficient conditions for "r-quick" convergence in the strong law for an i.i.d. - sequence can be given in terms of moments. A result, similar in spirit, is obtained for the strong law for a stationary sequence of bounded dependent r.v.. The necessary condition is given in terms of the mixing rate of the stationary sequence. Sufficiency cannot be guaranteed in general but for the important class of stationary renewal sequences the converse is valid. As a side-result a converse to limit theorems in renewal theory is obtained.

KEY WORDS: strong law, stationarity, mixing, renewal theory

Friday 2:30 - 2:50

ON A VERY WEAK BERNOULLI CONDITION

Richard C. Bradley
Indiana University, Bloomington

Eberlein has proposed a generalization of Ornstein's "very weak Bernoulli" condition for strictly stationary sequences of random variables, motivated by probability-theoretic (rather than ergodic-theoretic) questions. Dehling, Denker, and Philipp showed that the "mixing rate" in this definition of vwB cannot be $o(1/n)$ except when the random sequence is i.i.d. Here a class of strictly stationary sequences is constructed which shows that, in essence, any mixing rate that satisfies a mild convexity condition and is not $o(1/n)$ is possible for this vwB condition. Relationships with other mixing conditions are discussed.

Key words and phrases:

Very weak Bernoulli, strong mixing, maximal correlation, Wasserstein distance

Friday 2:55 - 3:15

WEAK CONVERGENCE OF WEIGHTED AND SPLIT MULTDIMENSIONAL EMPIRICAL PROCESSES WITH TRUNCATION

Michel Harel

Institut Universitaire de Technologie de Limoges, France

Among all the suggested methods of etablishing the convergence of rank statistics, one would be to write these statistics in the form : $T_n = \int r^{-1} L_n \, r \, d\mu_n$, where T_n is the rank statistic, L_n the rank process centred and normalised, μ_n a signed measure, r a positive or null continuous function, and to verify on the one hand the weak convergence of the measure $r \, d\mu_n$ and on the other hand the convergence with respect to the Skorohod topology of the process $r^{-1} L_n$. A first stage, before the convergence of $r^{-1} L_n$ is the convergence of $r^{-1} W_n$ where W_n is the empirical process centred and normalised. In this talk we give the necessary conditions for the convergence of the process $r^{-1} W_n$ with respect to an array of non stationary φ mixing $\mathbb{R}^k$ - valued observations. With the general hypothesis that we use we have to define the new notions of split process and split Skorohod topology (These results should be published in "Annales de l'Institut Poincaré" 1983).

Key words : split multidimensional empirical process, split Skorohod topology, split weighted functions.

Friday 3:20 -3:40

PERTUBATIONS OF RANDOM MATRIX PRODUCTS

Y. Kifer

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If $X_1, X_2, \ldots$ are identically distributed independent random matrices with common distribution μ then with the probability 1 the limit $\Lambda_\mu = \lim_{n\to\infty} n^{-1} \ell n \|X_n \cdots X_1\|$ exists. Suppose that matrices from supp μ have no more than one common proper invariant subspace or the same is true for the distribution μ^* of the adjoint X_i^* then for any sequence $\mu_k \to \mu$ in the weak sense, $\Lambda_{\mu_k} \to \Lambda_\mu$ provided some natural equiintegrability conditions hold. Some other cases of convergence and noncovergence of Λ_{μ_k} to Λ_μ will be discussed, as well.

Friday 3:45 - 4:05

MARTINGALE MODELS BASED ON FELLER-DYNKIN DIFFUSIONS

John Brode

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This paper will concentrate on the construction of models based on sub-Markovian Feller-Dynkin diffusions. Such processes allow creation and annihilation. They include, in particular, processes based on symmetric stable distibutions with a characteristic exponent between 1 and 2. Certain natural processes can be modeled by a Cauchy problem based on an ordinary diffusion. Proof of existence and unicity of the solution to the model depend on the square integrability of the process. Although the processes considered here are not square integrable, they can be appropriately defined on the complex field so that existence and unicity can be shown.

SOLUTIONS OF EVOLUTION EQUATIONS BY STOCHASTIC CHARACTERISTIC METHODS

Marc Berger and Alan Sloan
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The stochastic characteristic technique of solving an initial valve problem for a diffusion equation produces a process associated with the diffusion so that the solution is the average of random samples of initial data based on the process. The authors use similar techniques to represent solutions of linear differential evolution equations of arbitrary order. In the constant coefficient case, this is accomplished by introducing an Ito type calculus of differentials, $(dt)^r$, for r rational between 0 and 1. For parabolic equations, finite Riemann sum distribution approximations of stochastic integrals lead to product formula representations of solutions.

Keywords: Evolution equations, stochastic calculus, characteristic method, Ito calculus, product formulas.

PROBABILISTIC SOLUTION OF THE DIRICHLET PROBLEM FOR BIHARMONIC FUNCTIONS IN DISCRETE SPACE

Author Not Known

The probabilistic formula for the solution of the Dirichlet problem for harmonic functions is well known and has been extensively investigated. A probabilistic formula for the function f which is biharmonic in a given domain and which is specified by the values of f and Δf on the boundary was discovered by Has'minski and independently by Helms. A more difficult problem is to specify a biharmonic function f in terms of the values of f and its normal derivative on the boundary; that is, Dirichlet boundary conditions. Considering difference operators in discrete spaces instead of differential operators in Euclidean spaces, we investigate a probabilistic formula for the solution of the Dirichlet problem for biharmonic functions.

Keywords: Biharmonic functions, Dirichlet problem, Dynkin's formula

LAW OF LARGE NUMBERS AND CENTRAL LIMIT THEOREM FOR CHEMICAL REACTIONS WITH DIFFUSION

Peter Kotelenez
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Two mathematical models of chemical reactions with diffusion for a single reactant in a one-dimensional volume are compared, namely, the deterministic and the stochastic model. The deterministic model is given by a partial differential equation, the stochastic one by a space-time jump Markov process. By the law of large numbers the consistency of the two models is proved. The deviation of the stochastic model from the deterministic model is estimated by a central limit theorem. This limit is a distribution-valued Gauss-Markov process and can be represented as the mild solution of a certain stochastic partial differential equation.

Key words and phrases: Reaction and diffusion equation, thermodynamic limit, central limit theorem, stochastic partial differential equation, semigroup approach

Friday 3:45 - 4:05

COST BENEFIT ANALYSIS OF SYSTEMS SUBJECT TO INSPECTION AND REPAIR

M.N. Gopalan
I.I.T. Bombay

The paper deals with the cost benefit analysis of systems subject to inspection and repair. Various inspection strategies have been proposed. System characteristics such as a) pointwise availability of the system, b) expected up-time of the system in (0,t), c) expected inspection time in (0,t), d) expected repair time in (0,t), e) expected number of inspections in (0,t) and f) expected number of repairs in (0,t) have been obtained by identifying the system at suitable regenerative epochs. These system characteristics have been made use of in the cost benefit analysis of the system. A few numerical results have been obtained for certain special cases.

CENSORING AND CONDITIONAL SUFFICIENCY IN A MARKED POINT PROCESS SETUP

E. Arjas and P. Haara
University of Oulu

Complicated failure time data, including deterministic or random covariates and censored observations, is conveniently modelled in terms of marked point processes. In so doing, the marks are classified in a natural way into "innovative" and "non-innovative" (of which typical cases are the death and the censoring of an individual). We formulate a sufficiency condition in terms of the compensator measures associated to the point processes and show how this condition leads, in the above general setting, to a likelihood expression of a rather simple form.

Short title:
On censoring and marked point processes

Key words:
Failure times, censoring, sufficiency, point processes, innovation

RF SIGNALS PERTURBED BY OSCILLATOR PHASE INSTABILITIES

Vincent C. Vannicola and Pramod K. Varshney
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Statistical properties of oscillator frequency and phase instability are determined through use of the covariance matrix and characteristic function. The relation between stationarity, ergodicity, and instability parameters such as phase and frequency probability density function, initial conditions, drift mean and variance are established. First and second order statistics are investigated along with power spectral density. Emphasis is placed on the rf oscillator signal output with and without envelope modulation. The perturbing oscillatory driving force is modeled to include white phase, random walk phase, and random walk frequency. The interelationships of these models with stationarity and ergodicity are determined.

ON THE UTILITY OF SOME PROBABILITY DISTRIBUTIONS FOR NUMBER OF BIRTHS

S.N. Singh
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Some probability distributions for the number of births in a given time interval are discussed. The distributions take account of several demographic and biological factors. They have been utilized to explain observed distribution of females according to number of births (data from the Demographic Surveys conducted by the Centre of Population Studies, Banaras Hindu University).

Short Title : Probability distribution for births.

Key words : Human reproduction, Demographic, Biological factors, Birth distribution.

Friday 3:45-4:05

EXACT DISTRIBUTIONS OF THE MAXIMUM OF SOME GAUSSIAN RANDOM FIELDS

Robert J. Adler
Technion - Israel Institute of Technology

Determining the exact distribution of the global maximum of a Gaussian random field over a fixed N-dimensional rectangle has proven to be a surprisingly difficult problem. Indeed, even for the Brownian sheet, whose one-dimensional analogue, standard Brownian motion on the line, almost trivially yields the distribution of its maximum via the reflection principle, the exact form of the distribution of its maximum is not known.

We shall discuss this problem, and present a number of new results (mostly joint with Larry Brown) relating to Brownian sheets, related processes arising as weak limits of multi-dimensional empirical distribution functions, and a particular stationary Gaussian field which generalises the one-dimensional Slepian process.

Thursday 5:40-6:00

SOME LIMIT THEOREMS FOR WEIGHTED SUMS OF SEQUENCES OF BANACH-SPACE VALUED RANDOM VARIABLES

X.C. Wang and M. Bhaskara Rao
Jilin University, China and Sheffield University, England

Let $\{X_n, n \geq 1\}$ be a sequence of random elements taking values in a separable Banach space B. Let $\{a_{nk}, n \geq 1, k \geq 1\}$ be a double array of real numbers. Some new results are derived concerning the convergence of the weighted sums $\sum_{k \geq 1} a_{nk} X_k$, $n \geq 1$ (a) in Probability, (b) in the p^{th}-mean and (c) almost surely.

Key words. Separable Banach space, Random elements, Convergence in probability, Convergence in the p^{th}-mean, Strong convergence.

Thursday 5:40-6:00

ON STOCHASTIC ALGORITHMS CONSIDERED BY LJUNG AND KUSHNER AND CLARK

Michel Metivier
Ecole Polytechnique, Palaiseau Cedex, France

We consider stochastic algorithms of the type $\theta_{n+1} = \theta_n - \gamma_{n+1} V_{n+1}(\theta_n, Y_{n+1})$ (*) where $\{Y_n\}$ is a Markov chain controlled by $\{\theta_n\}$, $\Pi(y,\theta;dy)$ is a probability transition indexed by θ, and $P[Y_{n+1} \in A | \theta_0,\ldots,\theta_n,Y_1,\ldots,Y_n] = \Pi(Y_n,\theta_n;A)$. We assume that for θ fixed the Markov chain with transition $\Pi(x,\theta;dy)$ has a unique invariant probability m_θ and that, setting $\bar{V}(\theta) = \int V(\theta,y) m_\theta(dy)$, the Poisson-equation $(\Pi_\theta - I)h(\theta,y) = V(\theta,y) - \bar{V}(\theta)$ has a solution with Lipschitz regularity. Using a theorem by Kushner and Clark [1] and under some regularity assumptions on $\bar{V}$ and Π we prove the following result, which extends to many respect the classical theorem of Ljung [2]. Let $\{(\theta_n(\omega)): \omega \in \Omega_0\}$ be a set of realizations of (*) such that $\forall\, \omega \in \Omega_0$, $\sup_n ||\theta_n(\omega)|| < \infty$ and such that $\{\theta_n(\omega)\}_{n\geq 0}$ visits infinitely often a compact A included in the domain of attraction a stable equilibrium θ^* of $\frac{d\theta}{dt}(t) = \bar{V}(\theta(t))$. Then for P-almost all $\omega \in \Omega_0$, $\lim_n \theta_n(\omega) = \theta^*$. If $\bar{V}$ has only one stability point with domain of attraction $\mathbb{R}^d$, it is then enough to prove $\sup_n ||\theta_n(\omega)|| < \infty$ a.s. to get the a.s. convergence of $\theta_n(\omega)$ to θ^*.

References

[1] H.J. Kushner and D.S. Clark (1978). Stochastic approximation methods for constrained and unconstrained systems. New York: Springer-Verlag.

[2] L. Ljung (1977). Analysis of recursive stochastic algorithms. I.E.E.E. Trans. Autom. Control. AC 22, no. 4, 551-575.

ON THE KOLMOGOROV-FELLER EQUATIONS FOR CUT-OFF MARKOV PROCESSES

Josef Giglmayr
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Results on cut-off Markov processes (obtained by killing) are well known for the time homogeneous case [1]. For the general case presented (time and state dependent killing of jump and diffusion processes) our investigation is based on the joint transition probabilities $\bar{F}(s,x;t,\bar{B}) = \int_{\bar{B}} [1-\Pr\{s<T^+\leq t|\bar{X}_t=y\}]F(s,x;t,dy)$ which for suitable small $t-s>o$ can be expressed by $\bar{F}(s,x;t,\bar{B}) = \int_{\bar{B}} [1-c(s,y)(t-s)]F(s,x;t,dy) + o(t-s)$ (c is the killing rate, T^+ the life time and $\bar{X}_t$ the cut-off process on a locally-compact space). The solution of the corresponding Kolmogorov-Feller equations by successive approximations (which implies some bounds for the killing rate) is presented and the improper condition $\bar{F}(s,x;t,\bar{E}) \leq 1$ is proved. Application situations in reliability theory (age-wear-dependent model of failure [2]) and in queueing theory (spectral analysis of interrupted service) are considered and discussed.

[1] S. Karlin, S. Tavare, A diffusion process with killing, Stochastic Processes and their Applications 13 (1982) pp.249-261

[2] J. Giglmayr, An age-wear-dependent model of failure and its description by cut-off Markov processes, 5th European Conference on Electrotechnics (EUROCON), Copenhagen 1982, Vol. 1, pp.112-116

Key words: Cut-off process, killing, joint transition probability, improper condition, age-wear-dependent failure model

Short title: On cut-off Markov processes

STOCHASTIC PROCESSES AND THEIR APPLICATIONS

TWELFTH CONFERENCE, JULY 11-15, 1983, ITHACA

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STOCHASTIC PROCESSES AND THEIR APPLICATIONS

TWELFTH CONFERENCE, JULY 11-15, 1983, ITHACA

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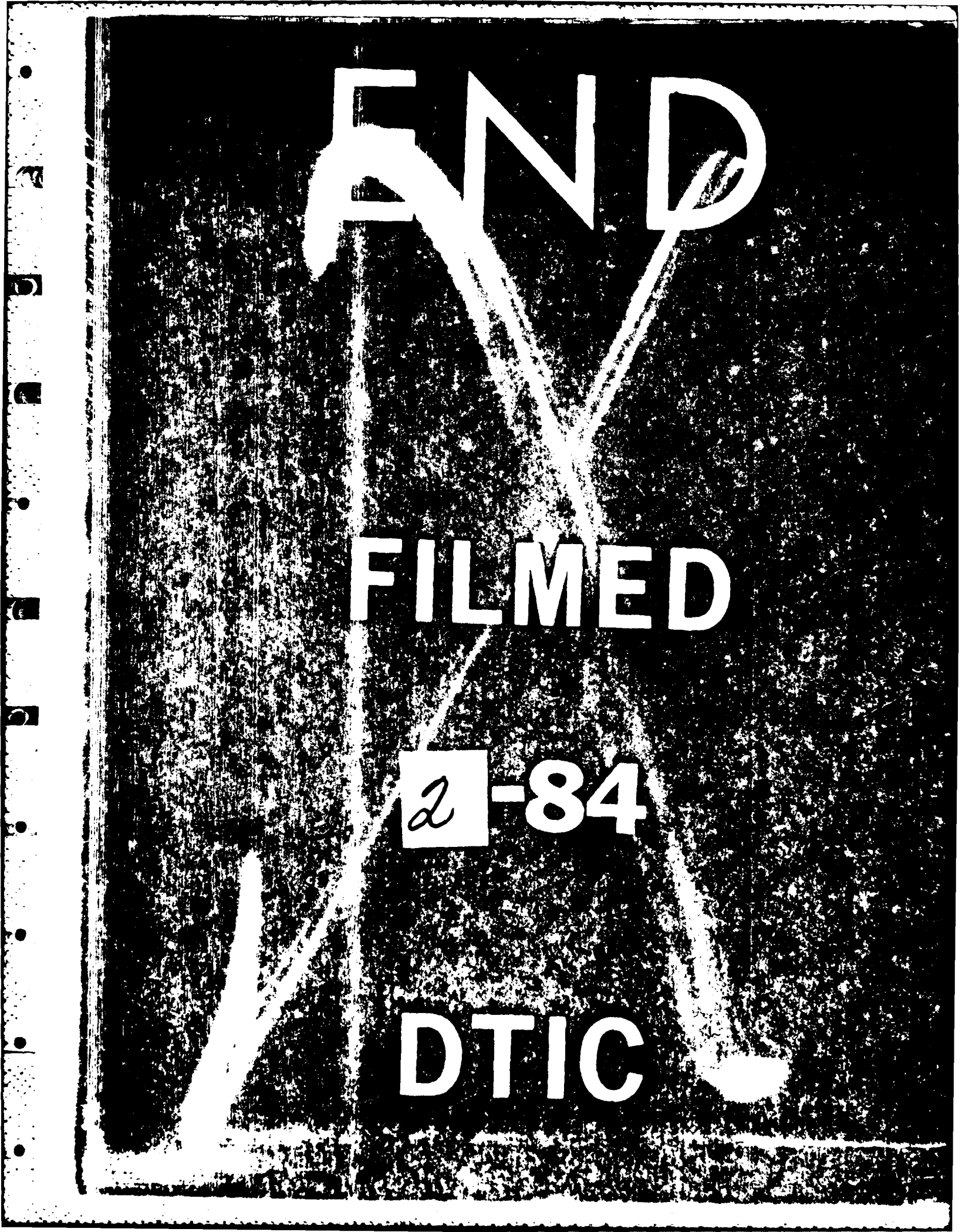
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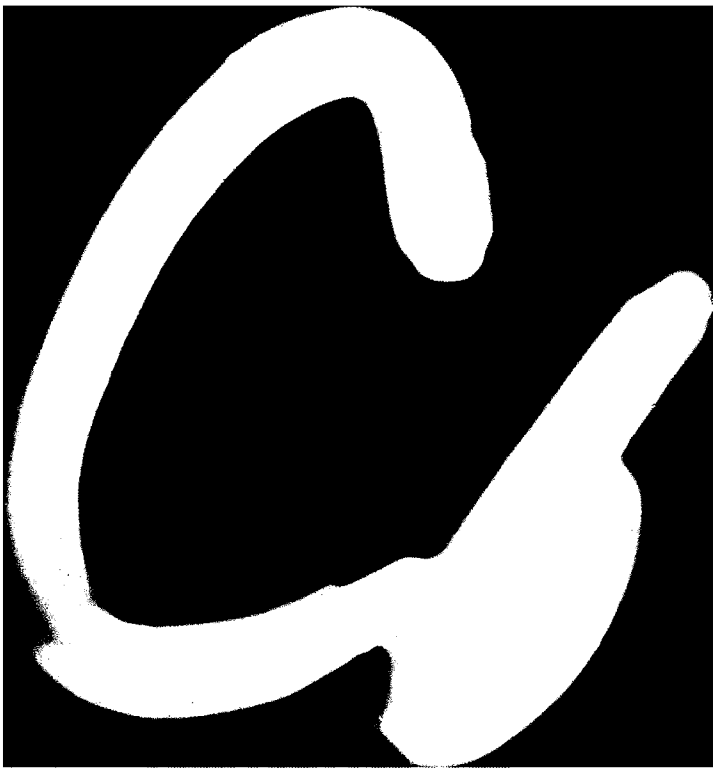

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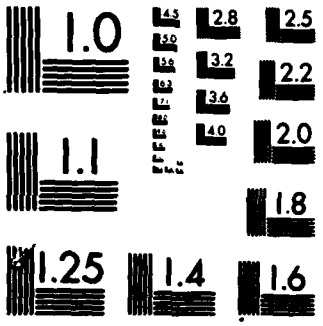

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16. SUPPLEMENTARY NOTATION
12th Conference, July 11-15, 1983, Ithaca, NY; Arranged under the auspices of Committe Conferences on Stochastic Processes of the Bernoulli Society for Mathematical Statisti

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB GR	

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This conference was the twelfth in a series of conferences arranged under the auspice of the Committee for Conferences on Stochastic Processes of the Bernoulli Society for Mathematical Statistics and Probability. It was sponsored by Cornell University, and partial funding was provided by the National Science Foundation, the Air Force Office of Scientific Research and the Army Research Office. The Conference was attended by 154 scientists coming from the U.S.A. (90), Canada (12), the Netherlands (8), West Germany (7), Israel (7), France (4), Great Britain (4), Italy (4) and several other countries. The scientific program consisted of 18 invited papers and 77 contributed papers. The invited speakers were E. Cinlar, E.B. Dynkin, R.A. Holley, J.H.B. Kemper R.P. Kertz, B. Mandelbrot, E.L. Porteus, R. Serfozo, L.A. Shepp, H.M. Taylor (U.S.A.) P. Jagers (Sweden), H. Kaspi (Israel), S. Kotani (Japan), P. Major (Hungary), J. Nevc (France), K.R. Parthasarathy (India), L. Russo (Italy) and M. Schal (West (CONTINUE

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ITEM #11, TITLE: TWELFTH CONFERENCE ON STOCHASTIC PROCESSES AND THEIR APPLICATIONS

ITEM #19, ABSTRACT, CONTINUED: Germany). There were 21 sessions of contributed papers arranged in three or four parallel sessions. The papers presented at the Conference covered a broad spectrum of topics in the theory and application of stochastic processes. The Conference's objectives were to encourage communication between 'abstract' and 'applied' probabilists, and to provide greater visibility to young promising research workers in probability. Both these objectives were amply met and the Conference was a great success.

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